UTOMATIC DATA PROCESSING
APRIL 1959 3/6

IARKET FORECASTING ORDER HANDLING ACCOUNTING FINANCIAL AND COST CONTROL DELIVERY SCHEDULING STOCK CONTROL
UTOMATIC MACHINE CONTROL PROCESS CONTROL DATA RECORDING AND REDUCTION COMPUTING FOR RESEARCH AND DEVELOPMENT

Automatic Data Processing

- *Planning a Government Installation*
- *The American Computer Market*
- *An Analogue Computer Checks Design*
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Electronic computers of various types are already in use in considerable numbers in Gt. Britain; but of those developed specially for commercial and industrial accounting applications, the National-Elliott 405 leads the field as the one most widely adopted for carrying out full-scale *integrated* data processing programmes.

Illustrated above: a twenty cabinet all-purpose installation incorporating four magnetic film units (for 'writing' and up-dating the 'main data file') and a high-capacity fast access disc memory for the storage of (a) programmes and (b) data selected, automatically for actual processing. (Additional Magnetic Core Memory and other advanced developments are incorporated in the 405M System).

National - ELLIOTT

405 & 405M

Electronic Data Processing Systems

The National Cash Register Company Ltd (Electronics Group) - 206-216 Marylebone Road - London NW1 - Tel: PADdington 7070

Automatic
Data Processing

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COVER PICTURE
The main entrance hall of Nielsen House, Oxford. See page 13.

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READING GUIDE ▶

READING GUIDE

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COMMENT

Considerations of Policy

SEVERAL milleniums ago, the wheel was evolved, somewhere in the valley of the two great rivers, Tigris and Euphrates, to enable the potter to shape his wares more quickly and more beautifully. How long or how soon afterwards we do not know, but it occurred to someone with sharp wits that the spinning disc on which the wet clay was shaped could be turned on its side and made to increase the mobility of heavy loads.

The computer may, like the wheel, find its true destiny in filling a need far removed from that for which its inventors intended it. It was evolved from a conspiracy between mathematicians and scientists on one side with electronic engineers on the other. These pioneers foresaw the industrial and commercial applications of the computer about as clearly as John Logie Baird foresaw the trading profits of the independent television companies. It was the second world war that first revealed the possible advantages of turning over the computer, like the wheel, to new uses.

Like most of us who put on uniform between 1939 and 1945, the computer had, with the return to peace, to earn its living. People in industry and commerce began to look at the possibilities of employing it to solve some of their problems. Other people, before the computer's potential uses had been at all clearly envisaged, at least had a hunch that it was going to prove useful in *some* way. The meeting of these two groups of ideas was in some degree fortuitous. There was little systematic matching of practical needs with the design and development of equipment.

This situation is changing rapidly. As businessmen increasingly think about the tasks they would like computers to perform, the manufacturers think increasingly about perfecting machines to perform precisely those tasks. Automatic data processing is the offspring of this marriage between technical invention and commercial need.

Thinking on the subject is still far from uniform and far from clear. Uniformity is not desirable; but there is something to be said for a common goal and everything to be said for clarity. For some time thought has been obscured, at least for many businessmen, by the combined though unco-ordinated assaults of the esoteric language of scientists and the jargon of salesmen.

The instrumental complexity of the computer has been allowed to dazzle the minds of technologists and to baffle the minds of businessmen. Consequently those to whom it could bring great benefits have hesitated to raise a clamorous demand for it. This initial reluctance has of course been strengthened by the costliness of the equipment and the costly work that is an essential preliminary to its installation.

So formidable has been the array of forces to discourage people from adopting the techniques of automatic data processing that, upon reflection, one is surprised more by the magnitude of the response to its challenge than by the hesitancy that has been alleged. The most formidable of all these impediments is also the greatest challenge to man's mind and character. It is the compulsion to think.

The installation of a system of automatic data processing presupposes a high degree of administrative efficiency and a complete understanding of the anatomy of control. There is no statistical evidence to show how extensively these conditions are fulfilled in, for example, commercial organisations and industrial plants; but anything like perfection is probably quite rare.

A system which relies primarily upon human hands and brains is 'self-adjusting' in the sense that it has the ability to compensate for most of its defects. Mistakes can be discovered and corrected, at the cost of occasional 'overtime,' perhaps, but with enough regularity to keep the organisation running at least with the appearance of efficiency. The more highly mechanised the system, the more rigidly intolerant does it become of occasional human failures. Consequently, human effort—especially clear thinking—has to be concentrated upon the efficient planning of the system instead of being spasmodically exercised upon the solution of isolated problems.

This is the great merit and challenge of the computer, even while it is its most obvious weakness. Realisation of the mechanistic rigidity of the system ought to dispose of much of the romantic awe that the machine tends to attract. Its value in industry and commerce depends upon the need for frequent repetitions of a small number of fundamentally simple formulae: it depends upon the need for 'mass production' of data. Ideally, if a computer system is economically used, it should reduce the quantity of data, as it eliminates superfluous operations. It is easy to foresee, however, that the emphasis that is sometimes put on speed and quantity may have the opposite effect. It may create a demand for quantities of data for their own sake, in obedience to Parkinson's law.

The only merit of this development would be to compensate for the supposition that a computer installation can justify itself only in terms of the human beings whom it renders 'redundant.' It is tempting to follow this line of thought *ad absurdum*, to a vision of society consisting solely of machines and a helot class of programmers; but before we approach this brave new world we may have learnt to evaluate the computer rationally.

The compulsion to plan the smaller units of industry and commerce to accommodate themselves to the benefits offered by the computer will help in the larger need to plan the economic use of the world's limited resources. As a technical device to aid us to meet the needs of a world population growing at an alarming rate, it has come none too soon.

Innovations and Applications

by ANDREW BOOTH, D Sc, Ph D

Reader in Computational Methods, Birkbeck College, University of London

IN this second article it is proposed to attempt a prediction of the way in which computer progress may be made in the next decade and, as in the previous article, the discussion will be divided into two parts, one dealing with technical innovations and the second with applications.

When technical innovations in an expanding field and over a relatively long period like 10 years are considered, prediction is dangerous and difficult. If such prediction were required only in the context of British industry, things would not be too bad, because devices at present in laboratory operation will probably be appearing in commercial equipment towards the end of this period. In the United States, however, under the spur of Russian technological progress, this pedestrian progress is not likely to be the case, and the experimental device will pass from the laboratory to the production line in a far shorter time. However, in the field of computing machines, short of one or two ideas which are necessary, but which will require an act of genius for discovery, it rather appears that the technical facilities of the present day are not likely to be greatly exceeded in the next decade.

In the first place, the most obvious thing that is likely to occur is that the use of solid state devices such as the transistor will become universal in the computing machine field.

The problem which besets the machine designer of the present time is that of storage. This has not yet been solved in any wholly satisfactory way. The idea of hierarchical storage, mentioned previously, is a good one which certainly makes the best of several bad jobs at a relatively small increase in computing time but, nevertheless, it is æsthetically unsatisfying, and the ideas of the early designers, for a single large high-speed store, should certainly be the aim of the idealistic designer. This does not at the present time seem likely to be achieved. Hierarchical storage will continue, and it appears almost certain that the highest speed echelon will change from consisting of a matrix of ferrite cores, as at present, to using extremely thin magnetic films deposited in vacuum on ceramic plates. These alloy films are already in the late development stage in several laboratories. They offer a speed-up of times of reading and writing, compared to those of the present day, by factors which vary according to the optimism of the research worker from 100 to 1,000. It seems quite likely, however, that the reading or writing of information on a thin film magnetic drum may take a time of the order 10 milli-micro-seconds. Having said this, it might seem that such devices are almost ready for incorporation in the computing machines of the near future. This, however, is not so.

The very great problem with any storage device which uses physically distinct storage elements, as do matrix stores, is that of reading and writing information. Various methods of transformer coupling and decoding which have been proposed (and sometimes built!) for ferrite core storage, do not lend themselves conveniently to application in the thin film matrix, and it appears that, at the speeds involved, some radically new techniques will have to be developed. The speeds of the devices themselves are also likely to cause a certain embarrassment. This is because in the milli-micro-second range the actual times of propagation of the electro-magnetic waves across the structure of the computer become important, and so considerations of geometry will obtrude with much greater force than at present.

Quite apart from propagation, there exists the problem of obtaining sufficiently rapidly changing wave-forms to make efficient use of the thin film stores when they are produced. One of the disadvantages of the transistor and allied semi-conductor devices of the present lies in the fact that they suffer from 'hole storage'—which means that, having passed a high current impulse for a short time, they behave as a short circuit in both directions following their initial operation. These problems are now coming to be better understood; and it may be hoped that the transistors of the next four or five years will be sufficiently advanced to make possible their integration with the thin film stores.

Magnetic Drums to Stay

The next phase of computer design which requires attention is that of the medium speed backing store. Here it is almost certain that the magnetic drum in one form or another will hold its place. Physical phenomena can be divided into classes and studied in a purely abstract way, and at the present time, with the exception of ferro-electrics, magnetics are about the only field in which permanent storage is possible—at least when the requirement of rapid alteration of stored data is imposed.

Although the magnetic drum, or some formal equivalent to it, is likely to persist, there is room for considerable improvement in the means of reading out information from the store. For example, present-day magnetic drums tend to attenuate information between input and output by factors of something like 10^6.

Various readout mechanisms which overcome this difficulty are theoretically possible, but many of them involve techniques, such as those of electron propagation *in vacuo*, which are technologically difficult at the present time.

Magnetic drum techniques in conjunction with those developed for electron microscopy may make possible, not only more efficient readout for magnetic storage, but also a far greater packing of data on to the drum surface itself. Very conservative figures for electron microscopic examination of magnetic surfaces seem to suggest that 1,000,000 bits of information per square centimetre would be a feasible and probably trivial packing in such a device. If magnetic drums are so developed, they are likely to replace magnetic tape in the third level of large-scale storage and it is probably safe to predict that such a development will be made and will become generally available towards the end of the coming decade.

In so far as a tertiary store is required for the computing machines of the future, which is capable of removal from the parent machine and processing elsewhere, it seems quite clear that magnetic tape will replace all present forms of subsidiary storage medium for this purpose.

Coming to the subject of input-output proper, this is a point which is capable of logical examination in the light of computer application. On the scientific side there is nothing wrong with paper tape, punched cards or magnetic tape. All are adequate and all are satisfactory. For use in commercial and economic contexts, however, quite different considerations apply.

Although it is quite possible that a fully automated factory might employ very few human beings, or none at all, for the recording of its operations, it seems likely that the human ancillary will still form the chief inspecting and accounting medium in commerce and industry. In this case it must be recognised that a major form of human communication is *via* the written symbol and that this claims pre-eminence even over that produced on a typewriter.

If it could be assumed that all input for computing machines was to be typewritten, then not only is there no difficulty, but also the mechanisms already exist for the direct preparation of paper and magnetic tape whilst the typed record is being produced, and therefore there is no need to handle the latter at all. Since, however, typing equipment of this sort is expensive and could not hope to find a place on the shop floor, it seems quite clear that means must be

devised to make direct use of the effusions of the human clerk, that is that the machines must be able to accept handwritten (and often badly handwritten) paper.

The problem thus divides itself into two parts: firstly, that of handling the paper, a purely mechanical task which should not be impossible of solution, and secondly that of recognising semi-legible symbols. These problems are at present under examination in a number of places.

It is quite certain that it will be impossible to recognise a single symbol without context with 100 percent reliability, but the work on machine translation has shown quite clearly the way in which context can be used to resolve the ambiguities which result from symbol imperfection. It is not even strictly necessary to make use of the elaborate procedures of machine translation, since codes can be devised which will enable the machine, by combining symbols together, to decide the intended meaning of a collection of symbols, some of which are illegible.

Speech as an Input Medium

Another form of input which may be of promise and of interest for the future is that of the spoken word. This has two distinct applications. The first is that of inventory control, where it might be desirable that a single operator carrying a small tape recording machine, and with a strategically positioned microphone, could both examine the stores and speak into the device, code numbers or words of real language descriptive of their state.

At the present time stocktaking tends to involve the use of at least two operators, one to check and the second to write, so that this particular innovation might be of considerable saving both in time and in money.

On the other hand an objection has been raised to the procedure: it is that stocktaking forms a useful way of introducing novice workers to the problems of the store, so that one of the pair of workers required for the operation is doing, whilst the second is learning, the job.

The second application for direct input of the spoken word to a computing machine bifurcates in two directions. First to the direct production of typed records where, for example, the business executive will be able to speak to his computing machine instead of to his dictaphone or secretary and, by giving the correct sounds to the machine, can arrange first that it hunts relevant documents for association with a letter to which he is replying, and second that it concocts a stereotyped reply with suitable variations to meet the particular case in hand.

The means by which these operations are to be performed are already well understood and pose no difficulties of a fundamental nature. It appears almost certain that the business world of 10 years' time will be provided with these ancillaries. Secondly, there is the self-evident application to language translation.

More Auto-codes

Finally, under the heading of technical innovations, the question must be asked—are present means of using computers optimum? In recent years it has been more and more remarked that considerable time is spent in the production of programmes, that is, sets of instructions, for the machine to operate on for the solution of a given problem, and that this is likely to impose a 'personnel bottleneck' on the machines of the future.

One method of avoiding the difficulty is to arrange that instructions to the machine can be typed in normal mathematical or commercial language, and this has already resulted in the production of so-called auto-codes for machine application. Auto-codes are already with us in various forms, and it is quite certain that their use will be extensive and mandatory during the next few years.

More Versatile Machines

The second point must be taken in conjunction with the speeds of the machines of the future. We have already mentioned the speeding up of storage by the use of thin films so that future machines are likely to be between 10 and 100 times as fast as those at present in use. This means that if a machine is to be stopped and re-instructed as to its actions at all frequently, the time wasted will slow it down to a speed which is almost that of present-day machines.

The solution to this problem is a simple one: it is that the machines of the future will make extensive use of routine-breaking instructions. For example, a commercially installed machine may be at work on a standard problem, say PAYE, and arrange that at the end of, say, every 10 sequences of operations it examines a switch which is connected to the outside world. If the user wishes to insert instructions to the machine to carry out some non-bread-and-butter operation as a priority,

he places his tape, or some other input medium, in the receptor and depresses the routine-breaking key. The machine, on next examining this particular point, disposes of the work which it at present has in hand, and arranges for its subsequent starting up, and then takes the priority programme which is waiting at its input. When this priority has been disposd of, output is produced and the machine returns to its more pedestrian operation until other work is available for it.

This idea can, of course, be extended to a very large number of inputs which are examined in turn. Among these inputs, priorities can be established whereby, for example, the design department of an aircraft factory has priority over a routine clerical operation which is of little interest in the over-all scheme of things.

So much, then, for technical innovations. No doubt these will seem as disappointing to most readers as they do to the writer of this paper. Nevertheless, our technical achievements over the last decade have been so great that we may hope that new devices, particularly in the fields of storage and switching, may make their appearance and so render many of our predictions too cautious.

Tomorrow's Computer Jobs

The major applications for machines of the next decade may well tend to drift away from science and technology. On the economic side, information retrieval and large-scale search are the cardinal features. One aspect of this is machine translation, which may become commercially feasible, particularly when large groups of languages and large volumes of publications, such as those appearing from the Soviet Union, have been considered. Another aspect is the problem of cradle to grave recording in economic planning which has been envisaged in some recent pronouncements from the National Physical Laboratory. Scientific problems which are likely to come to the fore in the future are those involving three or four dimensions, for example in meteorology and aerodynamics.

In the field of pure commerce and industry, the major application of the machine in the next decade will be to over-all optimisation, and the elimination of the human as a decision-maker in industrial planning. The computer will be the centre of any large-scale organisation. It will be in possession of all relevant facts of the past and present of the organisation, and will decide in considerable detail the way in which production is to be progressed through a factory, how records are to be kept, how material is to be ordered, and so on.

In addition to these functions the machines will have connections to executive desks so that the humans may ask questions on the sort of priority basis already discussed. Output should only be produced when it is really required for human action, and the vast masses of paper which descend upon the desk of the modern executive will, it is hoped, be eliminated.

We have already mentioned devices which will accept directly written or printed records, and these should help to solve the problem of machine input as it exists at the present day. One of the outgrowths of this work, however, is likely to be the direct input of drawings and photographs to the machine. This is already possible, and computers of the future, with far greater information storage facilities than those which exist at present, will be able to perform various highly sophisticated operations on input data of the type described.

Two applications which come immediately to mind are, first, that of searching the patent literature for originality. This has already been achieved on a limited scale in the United States, where the literature of organic chemistry can be processed on a computing machine to determine the originality of a new compound, although at the present time this is not done directly from the printed or drawn structural formula. The second application of direct input of drawings lies in the integration of the computing machine to the machine tool of the future. A drawing will be passed to the scanning device of the computer which will then directly produce a control tape for a programmed machine tool. The stages by which this can be done are quite clearly defined at the present day. They await only fast enough computing machines with adequate storage capacity.

Original Thought from a Computer ?

Finally, there is the application of machines to scientific and philosophical thought. There are already certain indications that problems of using a computing machine for thought processes are about to be solved. In particular, a programme has been outlined which will enable a machine to prove theorems in geometry from a set of preassigned axioms. The extension of this work, so that a machine in the quiescent state, with its

bread-and-butter operations completed, will continue, as does an intelligent human being, to ruminate on various problems of its own devising, is likely to follow in the near future. Whether or not machines will produce original thoughts of high merit is somewhat doubtful in view of the complexity of neural networks.

Making Politicians Expendable

On the national and international scale it seems that towards the end of the 10-year period, computing machines will come into full-scale operation on problems of government. At present, there is a particularly interesting example of the way in which a machine would make a far greater and more sensible use of existing facilities than do the politicians. This occurs in the field of fiscal planning, where a cursory inspection of economic records reveals that our economy is in a state of exponentially increasing oscillation. On the one hand stringent measures of economy, such as raising the bank rate and restriction of hire purchase facilities, are imposed. These lead after quite a short time-lag to a state of depression in which unemployment is produced.

Unemployment is anathema to modern politicians, committed to the idea of the Welfare State. In a panic, therefore, they release all restrictions, and this in turn causes an almost immediate inflation, because of under-production and over-consumption. The inflation in turn gives rise to international complications and to terror in the hearts of the rulers. Measures of compensation are applied, which result in a recommencement of the cycle just described. A computing machine would at least take into account the question of damping out the oscillations in the cycle. It could not be accused of partizanship for people of any class or creed, and it would be hoped that at least the more intelligent members of the community would accept its rulings.

Since this implies that politicians are redundant, will they completely disappear? Although many will hope that this might be the case, it seems quite unlikely, and, although perhaps not in the next decade, before the year 2000 the curious situation may arise in which, instead of the worker indulging in a Luddite riot for the destruction of the machine, the same function is taken over by the politician.

WORKING ON DATA 2,000 YEARS OLD

Father Roberto Busa is Director of the first literary data processing centre in the world, at the Aloisianum, a Jesuit college of philosophy at Gallarate, Italy. A leading Jesuit scholar, Father Busa pioneered the machine analysis of literary and religious works. Here he is seen comparing a copy of the 'Dead Sea scrolls,' written about two thousand years ago and recently discovered at Khirbet Qumran, with the analysis printed on the printing unit of an IBM 705 computer.

Before and after installing a computer a number of jobs need to be done. Forward planning as to who shall be responsible for what will ensure that work is put on to a computer faster and that it will continue to be done efficiently

What Staff Does an ADP Installation Require?

By A L HELMAN, B sc

THE number and displacement of personnel actively engaged in an ADP installation can vary tremendously, but all the different structures—and there are as many as there are installations—are designed to the same end. The aims for any particular application are :

(1) Statement of objectives
(2) Analysis of problems
(3) Detailing the method of solution
(4) Translation of the method to computer language
(5) Proof of the method
(6) Production of results

It is not uncommon for the original objectives to have changed by the time (6) is reached, and here lies the most popular fault in data processing systems.

A typical arrangement of personnel is shown in the accompanying diagram (see fig. 1).

This scheme is readily simplified in smaller installations, where, for instance, the operations research, systems analysts, and programming groups may be collapsed into one section.

The Data Processing Manager

The administration of data processing activities is clearly not solely a function of any one department, since the system serves a company best when it serves all parts of the organisation, crossing departmental barriers, and linking all elements into one whole.

To this end the data processing manager should be able to confer and work on all levels, and it is essential that he have complete horizontal as well as vertical communications.

A committee to advise the data processing manager on applications is evidently necessary in an organisation of any size, where each department is highly specialised and an over-all concept is difficult for one person to attain.

In addition to directing the current data processing efforts of the organisation, and looking at future applications, the data processing manager must be responsible for advising the management on new data processing equipment. He must also keep abreast of advanced data processing techniques and, where necessary, instigate new methods of solving data processing problems.

Operational Research

The installation of an electronic data processing system should do far more than just transfer the

tedious repetitive clerical operations from manual to automatic procedures, although this is often the immediate objective.

Once the detailed records of an organisation are available to a computer, it can readily digest facts and figures and quickly present information to aid management decisions.

Since the war, a complete new science, operational research, has been developed, enabling method to be applied to problems that had hitherto been solved by guesswork and intuition. A vast literature, mainly written in very highbrow mathematics, has been published, and countless articles addressed to managements have appeared, and although operational research is certainly no Aladdin's lamp, there can be very few, if any, organisations that would not benefit by the introduction of an operations research team alongside their computer.

This team should certainly include a statistician, and other members would be engineers and scientists able to apply their methods to the problems of controlling commercial processes.

Systems Analysts

The most important group in the changeover from manual to automatic clerical operations is that of the systems analysts. On the plans and procedures suggested by them will depend the success of the ADP installation, and early successes are very necessary—both for the company as a whole, financially, and also for the morale of the data processing personnel.

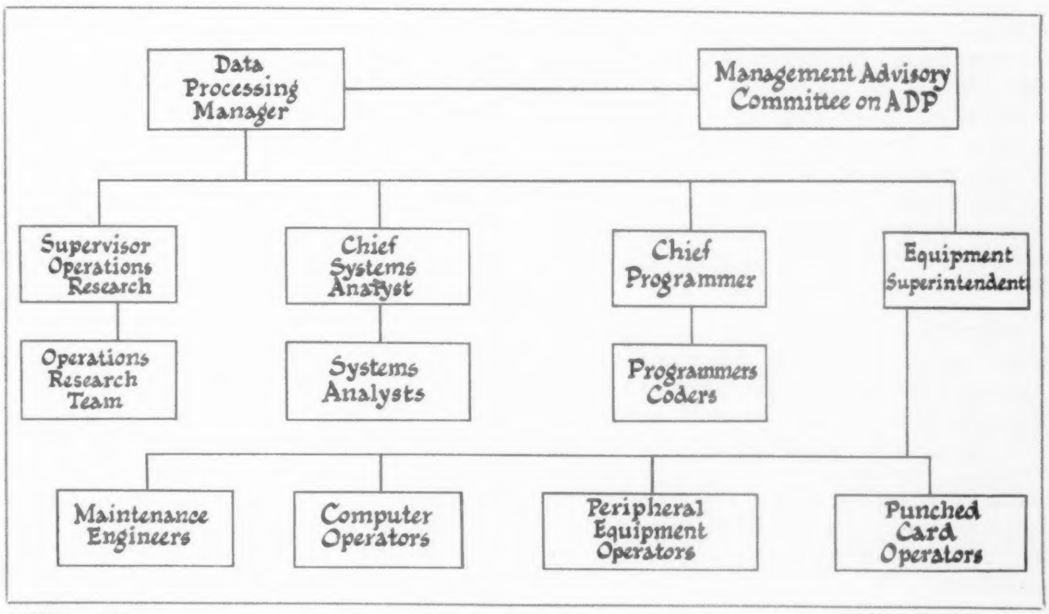
Given the objectives of a particular application, the analyst's prime duty is to plan the over-all method of attaining those objectives. He must produce details of the flow of information in the integrated system, and his plans must provide for all the exceptions that can arise. The methods arrived at must be so organised as to make the best use of the available data processing equipment; to this end a detailed knowledge of the capabilities of the equipment is essential, particularly of the computer and its associated units, since the optimum procedures for manual use will almost certainly not be the optimum for computer work.

The chief considerations in deciding the optimum method are the twin factors of time and cost. Since the greatest cost in most ADP applications is the computer processing, the aim must be to get the computer to do the maximum amount of useful work in the least possible time. This requires a joint effort from the systems analyst and the programmer.

Programmers

Ideally the job of the programmer should be to

Fig. 1.



translate that part of a procedure relating to the computer into computer language. In practice he does most of the detailed planning of systems as well. This seems inevitable whilst the number of people engaged in computer work is comparatively small, for the programmer is the only person in the organisation with sufficiently detailed knowledge of the equipment to understand its capabilities and limitations.

Experience teaches the programmer to look for exceptions; constantly to ask 'What happens if . . . ?' for he knows that computers, far from being electronic brains, are, in fact, electronic morons performing exactly as they are directed, and certainly not capable of using initiative.

The programmer, having accepted the objectives and the methods of an application from the systems group, details the flow of information in the computer on the various computer runs. Where necessary, he also designs input and output formats for punched cards, paper tape, or magnetic tape. Before the actual coding of the programme can be begun a 'block diagram' must be drawn, showing in minute detail the logic and methods to be used inside the computer. It is from this diagram, rather than from a knowledge of the over-all problem, that the coding takes place. Coding reduces each block of the block diagram to a sequence of basic instructions acceptable to the computer.

In the United States it is a common practice to distinguish between 'programmers' and 'coders,' the latter being a lower grade of staff, performing the somewhat tedious task of coding from the block diagram of the programmer. This division is sound in theory, but requires the programmer to have a knowledge of the computer which is obtainable only if he acts as a coder-programmer. Once he stops coding, he also stops learning the new and intricate tricks his computer may be made to perform.

Before the programme can be used it must be tested and proved. Errors will normally have occurred at the block diagram and coding stages, many of which can be eliminated by careful checking, prior to the programme reaching the computer. Testing on the computer is done by means of processing information to which the answer is known. The testing must be comprehensive, ensuring that all conditions are correctly catered for.

Proof of a complete data processing application is considerably more difficult. It may be possible to perform the operations retrospectively, and compare results with those obtained by other systems. Alternatively, a period of parallel running of computer and manual methods can be instituted. Failing either of these methods, the results produced by the data processing system must be accepted as the best available.

Equipment Personnel

Once a system has been proved, control of it passes from the systems analysts and programmers to the machine room. There the equipment superintendent will be responsible for arranging the necessary punching capacity, peripheral equipment operations, and computer runs, and finally ensuring that any systems checks are correct before passing results to the customer department.

Procedures for the flow of data through the system will have been provided by the programmers, and machine room personnel are required only to obey a list of instructions. Possible exceptions to this are the computer operators, who may require a knowledge of coding, and will certainly be called on to use their initiative if things go wrong. This is particularly true where the computer is run on a shift system and programmers are not on call.

A by-product of any data processing installation is its team of maintenance engineers. They are responsible for the smooth running of all the equipment, and carry out regular preventative maintenance on the major components of the system. It is important that none of these components be out of action for any length of time, and the engineers must be capable of rapidly tracing and correcting faults while the equipment is in use.

The computer manufacturers all provide training courses for suitably trained electronic engineers, and in the case of equipment being rented rather than purchased, the rental normally includes the full-time services of engineers supplied by the manufacturer.

Clearly the growth of a data processing system can be a gradual process, starting with strictly limited applications and a skeleton of the staff described. Later, as experience and confidence in automatic data processing is gained, the scope of the application can be increased, simultaneously with build-up of staff and equipment.

Nielsen House, overlooking a 29-acre site in Headington, Oxford, is the largest building outside the United States devoted to market research operations

Market Research: An 'Ideal' Application

by ROBERT McKINNON

A retail audit and an index of television audiences are two of the most important investigations undertaken by the A C Nielsen Company, using electronic computers

FEW industrial activities offer such a fruitful field for the latest techniques in automatic data processing as market research. Indeed, for the straightforward use of computers and ancillary equipment, the subject is almost ideal, involving as it does the amassing and speedy processing of vast amounts of data.

Today, market research techniques are being applied to a host of things, from detergents and canned foods to political opinions; and one of the largest firms in the market research business is the A C Nielsen Company, who are using automatic data processing equipment to give a better and quicker service to their clients.

The growth of the A C Nielsen Company is an index of the growth in demand for, and interest in, market research itself. The Nielsen organisation was founded in the United States in 1923 and nearly foundered during the depression, when the number of employees had to be cut down to six. It was saved by its invention of the Nielsen Food and Drug Index Services, which caught the imagination of leaders in those industries. Today the organisation furnishes 114 market research services from 19 offices in 11 different countries.

In terms of work, this means that the Nielsen field force each day gathers about 20 million new

facts and figures, and to convert these to a form useful to clients requires a daily total of 200 million statistical operations—or about 50,000 million each year.

Altogether, Nielsen's are operating about 1,700 contracts with more than 1,000 clients, and their work does not stop at processing data and printing results. Such is the vast amount of facts and figures presented in a typical report to a client that the company have found it necessary to run a special service for clients who, they say, may have 'neither the time nor the practical experience in this specialised subject to derive from these reports more than a modest fraction of the total value inherent in them'. As a result, more than 500 Nielsen employees are engaged in interpreting and applying reports to the specific problems of each client.

The turnover of the A C Nielsen Company, which is the British ally of the Nielsen Research Organisation, rose from £44,700 in 1941 to £852,500 in 1957. The British company now employs 1,150 people, 900 of them at Nielsen House, near Oxford. A further 200 are on field work and the remainder, in the company's London office, carry out the client service for the subscribers to Nielsen Television Index.

Company Services

Eight different types of market research service are available to the company's clients, but in practice almost all the working time is taken up by two main jobs: the Retail Audit Index and the Television Index. In addition, the company occasionally carries out special consumer surveys, 'one-off' jobs involving questionnaire interviews with some selected group—for example, householders, garage proprietors and small shopkeepers.

For all these jobs the company makes extensive use of automatic data processing equipment, and was until recently running an *IBM 650* computer 24 hours a day. Another *650* has since been rented to take some of the load off the first machine and to cope with increasing work, but in two years' time all the jobs at present handled on these two machines will be transferred to one much larger model—an *IBM 7070*.

In addition to the two *650* computers, other data processing equipment at Nielsen House comprises four IBM calculators, 15 tabulators, two *101* statistical machines, and various sorters, verifiers and collators. In all, there are 97 machines, and punched cards are used throughout.

The tabulating department make use of a battery of IBM 421-type accounting machines

To operate this impressive electronic assembly, there is a staff of over 50, not counting the girls who sort and verify the raw data sent in by the field force, nor the programming staff of six for the two computers.

The Retail Audit Index provides the A C Nielsen Company with its bread and butter, and comprises two-thirds of the company's total work effort. The clients here are nationally-known food and toilet goods manufacturers, and the service consists in providing them with up-to-date statistics on the value and volume of sales in selected areas. These sales figures cover not only the client's own products but those of his competitors in the same market.

Sampling Method

The sample upon which the Index figures are based must of course be wide and deep, for the client wants a picture of how his product is selling *vis-à-vis* those of his competitors, not only in the country as a whole, but also by type of district (e.g. town, surburban, country) and by type of shop. To this end, the Nielsen Retail Index divides the country into seven districts, using a pattern similar to that followed in the Board of

Trade's Census of Distribution. In these seven districts are 19 sampling locations, in each of which four different types of food and chemist shops are sampled—multiple stores and large, medium and small independent shops.

For each area, then, there are 76 sampling cells; and a special sample, by district, of co-operative shops is also taken. A mathematical formula is applied to the figures so obtained, which translates these into totals for all shops of the type under survey. Such totals cannot in the nature of things be 100 percent accurate, but they are accurate enough to give the client a valuable and confidential picture of the state of the market.

The 'raw' information is collected by Nielsen field workers from a total of 3,000 co-operating shopkeepers who are paid a fee (more or less nominal) for their trouble. These field workers do their job thoroughly; in fact, they do a stock count of the goods in their client's market in each establishment and write down the totals on pre-printed audit forms. One month food shops are surveyed, the next month chemist shops. With an exhaustive report every two months, the client thus has a continuous information service on the fate of his product. He knows how it is selling in the country as a whole and how it is doing in various parts of the country. He knows the type of shop in each area which is the best—or the worst—outlet for his goods; and he knows the same things about those of his competitors.

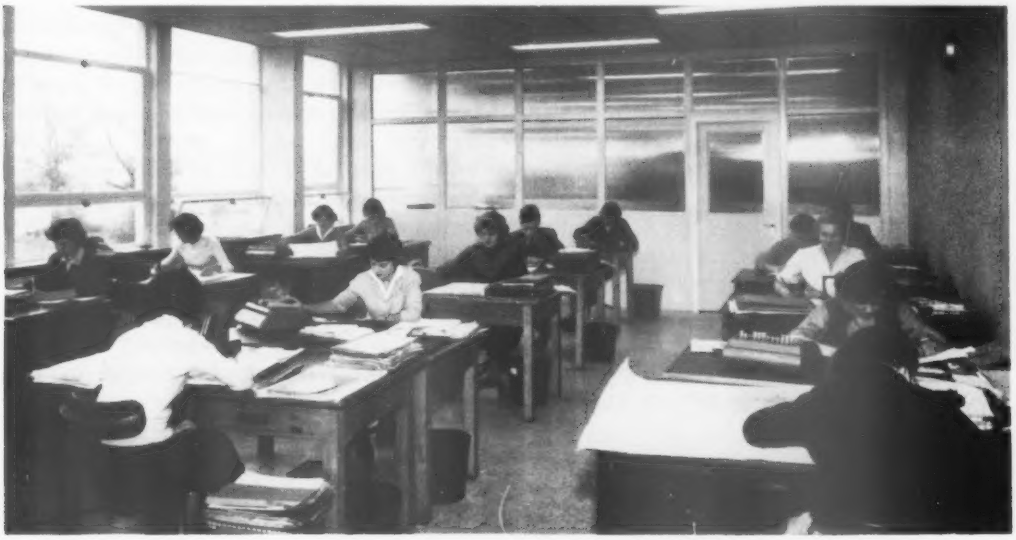
Processing

This, of course, is only possible because of the processing work carried out at Nielsen House on the 'raw' data supplied by the field workers. They send in their returns on the pre-printed audit forms, and the new balances are first checked by girls working a bank of adding machines. After they have been checked, the figures on the forms are converted on to punched cards, verified, collated and processed through a number of stages until they are ready for the computer.

After being processed on the computer, the findings are listed on the tabulators, reduced to a suitable page size by Xerox equipment, then printed by multilith. A special department prepares the art work needed for the reports, so that it is possible—and indeed it often happens—that the client's report is ready within 12 hours of the figures being taken from the tabulator.

The whole process is very much like factory flow-line operation. The raw material comes in and is subjected to a series of processing operations, ending with the printing of the report.

Accuracy in the Nielsen Organisation is achieved through statistical control. The general office of the Statistical Control department scrutinises operations and also devises samples of the company's research services



The same is true basically of the system by which Nielsen's produce their Television Index. The country is divided into selected areas, this time to correspond with the coverage of the various commercial TV networks, while the sample is taken not from a given trade group but from a cross-section of the general public. There are some 1,400 families co-operating with the company in this project, in return for which Nielsen's pay for the servicing of their sets.

Television Index

The object of the Television Index is to provide clients with confidential information on the habits and preferences of the viewing public, particularly on the following points: the percentage of people viewing commercial TV as opposed to BBC programmes at all and any times of the week; the percentage of homes with television, viewing at any given time; audience composition for the various programmes at various times of the day; the cost to the advertiser per 1,000 of any 'spot' commercial.

Obviously the methods used to collect the 'raw' information of the Retail Index would be useless for the television project. For this purpose, a special device known as an audimeter is wired into the circuit of the TV set. This device incorporates a spool of paper tape which rotates slowly on to another spool. It is calibrated at five-minute intervals and, when the set is switched on, a stylus comes down and traces a line on the tape. The position of this line indicates which programme is being received. Special machines at Nielsen House decode the information on these spools and transfer it to punched cards.

An audimeter of course cannot tell whether the programme is being looked at by a man, woman or child or all three, so co-operating families are asked to record this information at 15-minute intervals.

By these methods, Nielsen's get a more than adequate supply of viewing information, and their Television Index is heavily subscribed to by TV companies, programme contractors, advertising agencies and their clients.

The audimeter system is to be changed shortly for something better. Home samples will be on special telephone lines which will bring the information to a central point in each area. Here, it will be punched on to paper tape and the contents of that tape sent to Nielsen House by teleprinter. There, as before, the information will be translated on to punched cards and processed in the same way as the data for the Retail Index.

Accuracy Emphasised

These two indexes, then, form the bulk of the work at present undertaken at Nielsen House, and the company stress that 30 percent of the work consists of checking and verification. This is essential, for Nielsen's themselves draw attention to the fact that it is difficult for the client to check the accuracy of one of their reports. Accuracy, then, is the company's special responsibility; it is the yardstick of their integrity.

There are other factors, however, on which the success of a company in the market research business depends. The service must be continuous or repetitive. Moving pictures of a market are infinitely more valuable than still pictures. Moreover, the service must be capable of syndication. That is, except for special jobs, the same material must be saleable to two or more clients. Only then can the market research company afford the very best techniques; and in these days, that means the latest automatic data processing equipment and programming techniques, to give clients the best value for money.

A final and important point is that Nielsen's believe market research services such as they provide can make a genuine contribution to economic stability, as well as help to increase profits in more prosperous times. Past experience has shown them that, in periods of depression, *consumer* sales of the branded product show only a rather small decline, whereas *factory* sales usually drop at a rate which would be very frightening did the manufacturer not have the facts and figures to show him that the public was still buying his product. In other words, the apparently catastrophic decline is actually a liquidation of stocks by the wholesale and retail outlets. And when a client has this sort of statistical assurance he keeps his courage and stands firm.

Engineers collating an earthworks computation with original data

An Experiment in Co-operation

by E M CHASTAIN

President, Midwest Computer Service Inc

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Seven of the smaller engineering firms in the United States combined resources to form a computer pool to handle their data processing

MANY small- and medium-sized companies today need the services of modern high-speed electronic computers. In a competitive situation, however, a small firm appears to be at a distinct disadvantage because: (1) economic justification is difficult, and (2) it doesn't have enough work to keep the high-capacity computer busy.

Yet there is a way in which a company with a minimum or limited computer work-load can solve both of these problems. We believe the answer is a computer centre established and operated on a co-operative basis. This is a practical approach and it's an economical one.

Seven engineering firms, all but one located within one hour's drive of Decatur, Illinois, established the Midwest Computer Service, Inc., on a co-operative basis on January 31, 1958. During March and April we installed a Bendix G-15D general purpose digital computer and peripheral equipment, selected the staff, and trained the personnel. We gained momentum rapidly during May, our first full month of operation. And now we feel certain that our faith in the success of this centre has been justified.

Some authorities have described our venture as a 'unique pilot operation,' or as 'one of the first such co-operative computer undertakings.' Under the arrangement the seven participating firms, which range in size from 40 to 120 employees, not

Mr Jerry McCall, manager of the shared computer centre, discusses a problem with one of the clients

only can remain as competitors with each other but also can strengthen their respective competitive situations with the larger firms.

For many engineering firms, it has almost become a matter of getting a computer or getting out of the race. In structural analysis, for example, 10 minutes of computer time may be equivalent to two to four weeks of a designer's time. In solving major horizontal alignment problems, such as at complex road junctions, one machine hour may be equivalent to 350 man hours. In bridge geometry problems, work which may require 22 man days by manual methods may be completed in 10 to 12 minutes on an electronic computer.

Our firm, Homer L Chastain & Associates, first became interested late in 1956 in the use of electronic digital computers as an aid to our engineers in solving repetitive or complex geometric or mathematical problems. Early in 1957 we were able to process some work on a Service Bureau basis with computer installations in distant metropolitan areas. Our early optimism that such an arrangement might prove satisfactory was dampened because of the language barrier between our engineers and their computer technicians. The geographical factor of remoteness between our engineering offices and the computer centre, and difficulties in scheduling machine time for our work, accounted for days of delay in processing our data.

Late in the summer of 1957 we began making direct inquiries to various computer manufacturers to learn about the characteristics and capabilities of their equipment. It soon became apparent that the capacity of such equipment was greater than any foreseeable volume of work that would originate from our own firm. We then decided to discuss our problem—on a community basis—with other nearby consulting firms having a similar estimated volume.

Nine consulting engineering firms were repre-

sented at our initial meeting on October 18, 1957, where the following reasons for the establishment of a computer centre on a co-operative basis were outlined and discussed:

1. To provide our firms with a completely independent agency for the computation of time-consuming engineering problems. We all knew of the progress being made by some larger consulting firms and by several State Highway Departments in computer application, and the general consensus was that a computer service of our own would enable us to continue to apply the most modern and up-to-date engineering procedures to our design problems.

2. Decreased time required for processing work which would permit the examination of alternate designs, and so forth. In a representative example of an earthwork cut-and-fill project, for example, the time saving was shown as 30 to one and the cost saving in excess of 15 to one. Similar savings in time were shown in other engineering work such as vertical alignment, structure and hydraulic design. Engineers also could be released from time-consuming detail work for more creative and advanced engineering procedures.

3. Computers are a sales tool. Several industries and most State Highway Departments were using digital computers or were in the process of installing them. In soliciting business from such prospects, we would be able to talk with their engineers in their own language and, in many cases, process much of our work on equipment identical with that in their offices. We could bring to other clients the advantages of the electronic computer.

4. The capacity of the equipment is sufficient to serve a multiple number of comparable engineering firms. The co-operative approach permits distribution of an annual budget among several participants without sacrificing productive time.

Enough interest was expressed among those present to warrant further investigation of the proposed project. The group later invited some computer manufacturers' representatives to a meeting. That move proved to stimulate previously expressed interest and led to a preliminary organizational meeting on November 26, 1957.

It was decided that a committee of three investigate and report back to the group its definite proposals covering: (1) type of organization best suited for the operation, (2) equipment to be provided, (3) operating budget for one year, (4) method of financing, (5) location of computer service office, and (6) other pertinent information. The committee was voted $1,500, the charge to be pro-rated equally among the firms present, for travel expenses and for legal and accounting fees. During December the committee visited a number of service installations, computer manufacturers, State Highway Departments, the Bureau of Public Roads in Washington, DC, and the Massachusetts Institute of Technology.

The committee report, prepared upon completion of the investigation, was presented to the January 18, 1958, meeting of the sponsors:

1. The committee recommended the computer

One of the clients checks the preparation of input tape while it is being prepared on the flexowriter

service should be established as a corporate entity—operating as a complete organization separate from any of the participating corporations and partnerships. Stock should be subscribed to equally by the member firms, and control vested in a board of directors with one director selected by each participant.

2. After comparing computer features such as availability, capacity, speed, cost, auxiliary equipment needed, staff requirements, special installation requirements, users' co-operative benefits, and anticipated manufacturer's co-operation, the committee recommended the acquisition of the G-15D general purpose digital computer from the Computer Division of Bendix Aviation Corporation on a rental basis.

3. On the assumption it would require three months to set up the service centre before actual installation of the computer, the first period of participation was set for 15 months, with the following operating budget: —

Supervisor	**$14,000**
Programmer	**8,000**
Two Technicians	**10,000**
Machine Rental (Bendix G-15D)	**18,000**
Machine Purchase (Flexowriter)	**3,000**
Office Rental	**1,500**
Furniture and Equipment	**2,000**
Utilities	**500**
Miscellaneous, including preliminary expenses incidental to setting up the centre	**3,000**
	$60,000

It must be pointed out that the positions of supervisor, programmer and technicians involving salaries of $32,000—more than half of the budget —are not normal costs in 'one firm' computer installations. Ordinarily, no added staff is required. The existing staff can be utilized, and the computer manufacturer will assume the responsibility of training the staff. We felt, however, that our computer centre should have an independent full-time staff to assist our individual firms and to give the greatest assurance of success to our venture.

4. Because of the need to guarantee the proposed budget, the committee recommended that the participating firms enter into a contract with the computer centre for an advance payment to be made at the time of stock purchase. A monthly service charge of $750 was suggested for each member firm, with the services to be used either by the member firm or by mutual agreement by another member firm.

It was suggested that each firm designate an engineering manager and an engineering technician. The engineering manager should be a top design man who could spend time on the development of programmes and on the use of the computer service to assure participation by his firm in the benefits of the computer and, significantly, to convince members of his own organization of the advantages of machine usage. The engineering technician, a civil engineer, should handle liaison between the consulting member firm and the computer service centre, and should be given special training at a computer school to learn programming and computer uses.

If seven firms agreed to participate it was estimated that the equipment would build up to a productive use 90 percent of the time—based on a 2,000-hour year. Since industrial companies, utilities and other commercial enterprises in the area were interested in time-to-time use of the facilities of a nearby computer centre, the following rates were suggested: —

Item	**Hourly Rates**
Supervisor (consultation, mathematical and numerical analysis)	**$15.00**
Programmer (flow diagrams, programming)	**10.00**
Technician (clerical)	**5.00**
Machine Time (G-15D)	**40.00**

For the selection of office facilities the committee suggested that special attention be given to requirements such as fire protection for valuable documents, proper security provisions to comply with government contract requirements, a work area for participating firms, a conference area for programming aid and for discussion, and a file area for programmes and typical business papers.

The committee's report and recommendations were adopted with minor revisions and the formation of the Midwest Computer Service, Inc., to be located in Decatur, Illinois, was authorized.

The computer manufacturer co-operated with us in the location of suitable office space, selection of office equipment and in screening and training of staff personnel to help us get off to a fast start. Another aid was the availability of a number of programmes through the Bendix Computer Users Exchange.

We feel we have found the answer to the problem of the smaller engineering firm which needs the services of a modern electronic digital computer, and we believe that other companies with similar needs may find a computer centre established on a co-operative basis worthy of detailed exploration and consideration.

Maintaining a Group Pension Scheme on a Computer

A large group of companies uses a computer service centre to operate a pension scheme for some 7,000 employees

by R HARRISON
IBM United Kingdom Ltd

AN illustration of the way in which a group pension scheme can be maintained on a computer has been provided at the data processing centre of IBM United Kingdom Ltd.

At the beginning of this year the first amendment run of a pension scheme for a large group of companies took place. The membership of this scheme is at present 7,000 and is expected to reach 10,000 within three years.

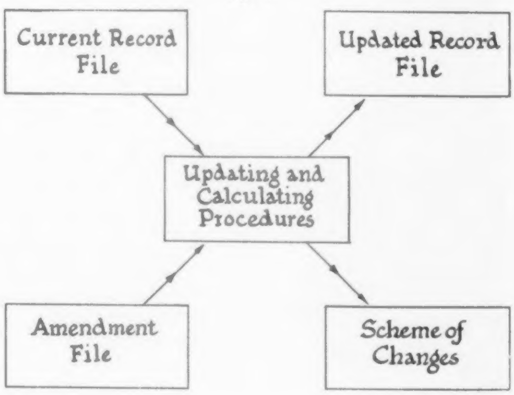
Although details will vary with particular schemes, the broad requirement remains the same for all. This is to update at intervals the information relating to each member of the scheme, and at the same time to calculate any new contributions, benefits and statistics arising out of amendments.

This problem may be represented diagrammatically (*see fig. 1*).

In the case of this particular group of companies a clerical system had been set up in 1939. Historical records for each member were held on handwritten cards and maintained centrally, but most of the work involved in the monthly and half-yearly calculations was first done by individual companies for their own guidance in the collection and forwarding of contributions, and subsequently checked by the central pension department. This led to duplication of work, delays while queries were answered, and a great strain on the pension department at each half year, or at times when many amendments became necessary.

The growing number of members in this scheme made additional demands on this department and, in consequence, the time taken to post amendments or update records grew longer. For instance, by the beginning of 1959 the yearly statistics which should have been posted on September 1, 1958, were still not completed. Now,

fig. 1



Putting the pension scheme on to a computer has cut out a great deal of work for the pensions department of the group of companies and made the scheme easier and more economic to maintain

with the computer, it is possible to post them on the day they are due.

Apart from the speed of processing records already existing on punched cards or magnetic tape, the computer is an efficient tool for carrying out such work.

All calculations relating to one scheme are similar in the sense that they are all determined by one set of rules. This is like the payroll process. Once the computer has been programmed to follow these rules it can proceed from one calculation to another at great speed.

The complex calculations often require reference to tables and, whereas clerks are notoriously prone to error, computers are ideally suited to this kind of work.

Checks can be incorporated into the programme to reduce the likelihood of accounting inconsistencies to the minimum.

When there is an increase in work arising at a review date, files are immediately up to date and contribution changes can be taken up immediately.

It was in view of this that the Organisation and Methods committee of this group decided, after discussion with IBM United Kingdom Ltd, to do this work on a service basis, and hire time on an *IBM 650* computer.

The Scheme

The membership of this scheme is open to all male members of the group of companies concerned whose salaries exceed £750 per annum. The pension department is responsible for maintaining the scheme, collecting contributions, paying pensions, etc. In fact, contributions are deducted from payments to employees by individual companies, and these are forwarded to the pension department each month. Thus, for accounting purposes, transfers from one company to another must be allowed for.

The main benefit is a pension payable on retirement at the age of 65. It is calculated at the rate of 1½ percent of the average salary for the final five years for each year of service.

There is no separate life assurance cover, but on death the benefit is either a return of all contributions paid, with interest, for a single man, or, for a married man, an immediate 50 percent of the final pension for the widow, together with the return of the member's contributions, with interest.

A reduced pension is payable on retirement on the grounds of ill-health.

On withdrawal from the scheme, either the member's contributions are returned with interest, or, in certain cases, a paid-up pension is granted.

Contributions have been calculated actuarially to cover the cost of the pension, and are split between employee and company. They are laid down in a table and depend both on the member's age on joining the company, and on the date of amendments. In all, this table has over 800 entries each for member and company.

One particular complication arises from the fact that any increase in contribution after an amendment has to be paid until the amendment anniversary prior to retirement. This means that the amount payable in the final year must be recalculated and stored after every amendment, and a special routine takes effect on the member's sixty-fourth birthday to spread this amount outstanding at retirement over the last 12 months.

The review period is one month, and all changes become effective from the beginning of the month nearest to this date of amendment.

Hence a monthly updating procedure is necessary, for which revised contributions must be prepared, as well as any arrears resulting from the backdating of an amendment.

In addition, an annual statement is sent to each member, notifying him of his pension secured to date, his annual contribution and total contributions to date, as well as his current death benefit. In practice, these are updated half-yearly totals of contributions paid by each company to the pension department.

Finally, a continuous record of the member's history in the scheme must be kept by the pension department.

Processing for the Scheme

The updating and calculating procedures illustrated in the diagram (page 21) are carried out for this group of companies on an *IBM 650* computer. The current record and amendment files are kept on punched cards.

For both monthly and half-yearly processes, record and amendment cards are simultaneously fed into the computer which then updates the record and punches a new card containing the updated information. A schedule of changes is printed automatically on an *IBM 407* printer.

Record cards used in the monthly run contain:

1. Member's number
2. Date of birth

New data relating to the scheme comes to the IBM Data Processing Centre once a month

3. Date of joining the scheme
4. Date of the last amendment
5. Age on joining the scheme
6. Current salary
7. Current pension secured
8. Current contributions for member and company
9. Contributions for member and company for the half-year to date
10. Amount outstanding on retirement.

Of this information, numbers 1 to 6 are used, in conjunction with the tables and rules stored on the magnetic drum of the computer, to calculate the new values of 7 to 10 as a result of every amendment.

During this process some 1,400 programme steps are used for each member, the calculations taking in all about one and a half seconds. When this scheme is converted to use the magnetic tape system this time will, of course, be reduced considerably.

In the half-yearly run the updated record card acts as the 'amendment' card and the 'brought forward' half-yearly card is in effect the 'record' card to be updated. Under the clerical system the half-yearly figures were arrived at by adding the six contributions that each member had made, but with the computer half-yearly figures are re-calculated as amendments occur, so that the half-yearly run may be completed at any time during the second half of the month. The member's annual statement can therefore be sent to him on the actual date to which it applies.

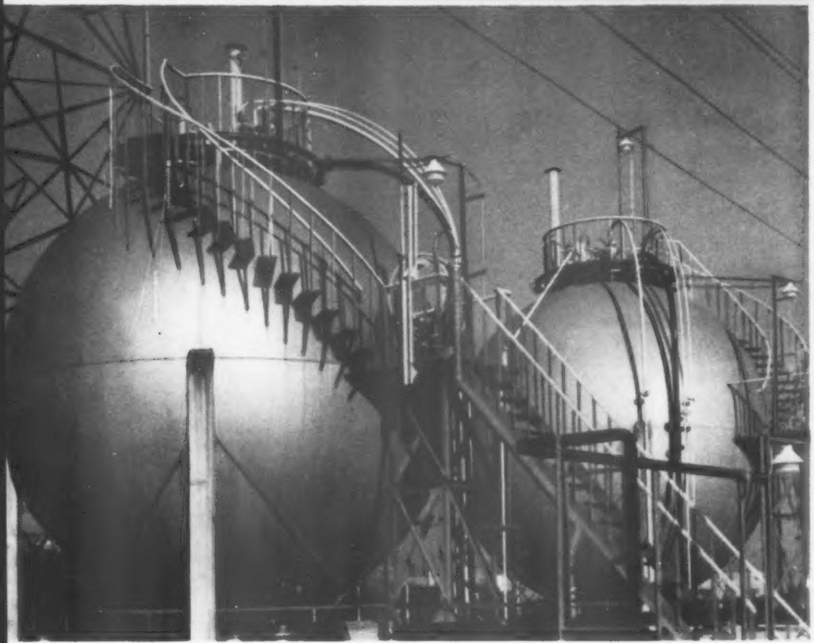
It is thus possible to meet most of the above requirements without difficulty, by using the computer. The maintenance of an historical record alone requires further attention.

When the new card is produced after an amendment, it completely replaces the old card in the current record file. To transfer the old card to the record file would not only produce a bulky file but, unless cards were interpreted, reference to it would be difficult.

Therefore a 'line posting interpreter' is used, the information on each old card being interpreted as a single line on to a blank card. These cards each hold up to 10 amendment lines for a particular member.

These monthly and half-yearly runs constitute the bulk of the work performed on the *IBM 650* computer. Some of the other work of the pension department will be taken on gradually, such as the special calculation needed at the end of the tax year, and for the five-yearly valuation. The new procedures will relieve both the pension department and the group companies of a very large volume of work and make the maintenance of the scheme easier, more efficient and more economic.

This use of a service computer on an hourly basis illustrates one of the ways in which a very wide range of commercial, industrial and scientific work is undertaken economically for organisations that either have not yet installed equipment of their own, or wish to supplement their own equipment by a more powerful machine.



Analogue computers are fast becoming recognised to be as useful a tool in the research laboratory and design office as the accounting machine is in the clerical office. After they examined and came to appreciate what they could do with analogue machines, Laporte Industries Ltd were quick to make use of an analogue machine to verify designs for a £2½ million hydrogen peroxide plant

An Analogue Computer Checks Designs For a Chemical Plant

FIRST developed ten years ago, electronic analogue computers were primarily designed to help to solve some of the problems confronting the guided weapons industry. In this field full-scale experimenting was costly and limited, so the analogue computer, with its ability to ' reproduce ' and solve designers' and engineers' problems, had an obvious value.

The aircraft industry, with many problems similar to those found in rocketry, has also found it useful, and problems connected with flight performances and airframe design—to cite only two examples—are among the many jobs that have been tackled.

However, the analogue computer is proving to be not just the aircraft engineer's handmaid; other industries are now finding new and quite different applications for the machines offered by a number of manufacturers.

Despite this, many executives are still puzzled as to what analogue computers do and why research workers want them, and consequently are hard put to decide whether a machine, which is always an expensive item to purchase, will bring economies or merely constitute an extravagant piece of laboratory hardware.

One approach to this problem is to consider an analogue machine as the laboratory equivalent of an office adding or calculating machine, for basically an analogue computer is a device for performing calculations—' a sort of electronic slide-rule,' as one manufacturer puts it. As such, it has attractive features: it can do calculations at very high speeds; and it is relatively simple to set and operate. In fact any electrical engineer can be taught to operate a machine in about eight hours and, with a week of practice and study, should be able to set up and run routine problems.

In electronic analogue machines physical quantities, such as temperatures, pressures and

areas—the 'raw material' that engineers and designers have to contend with—are represented by voltages and, of course, variations in these quantities are merely represented by voltage variations.

Consequently, the relationship that exists between various physical quantities can be 'reproduced' in a computer. This is merely a long-hand way of referring to the mathematical equations that engineers have to formulate before they can begin to solve problems. For example, a plant engineer who wants to know how fast a liquid will flow into a tank, first puts his working information—rate of flow, pipe diameter, etc—into mathematical form and then produces a 'working equation' which may well involve multiplying, dividing, adding and subtracting factors and constants. In addition, it may also involve more complex operations such as integration and differentiation. In this equation, if one or more terms varied continuously or were the result of a number of previous equations, then to try to find the solution by manual methods could be extremely tedious.

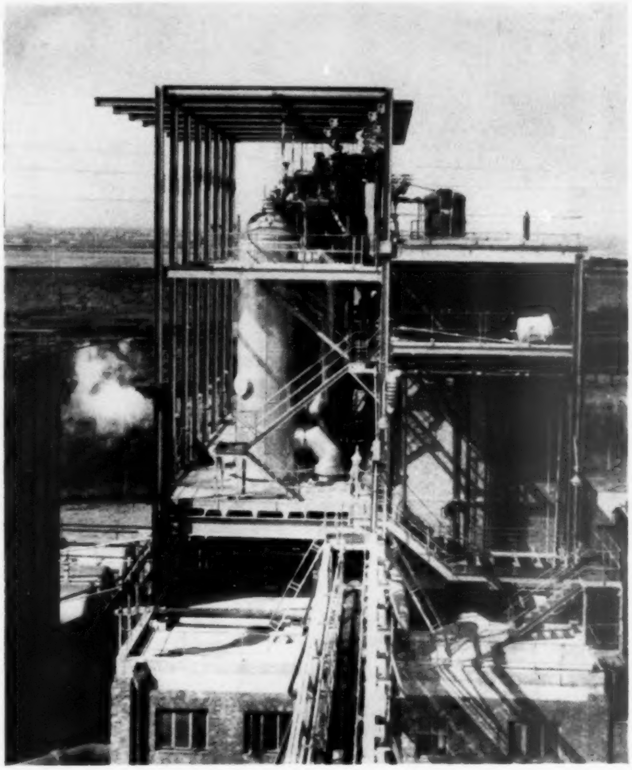
Simulating Problems

An analogue computer is built to handle this kind of mathematical work. It differs markedly, in its approach to such problems, from the digital computer, which can also solve equations. The digital computer actually *works out* the equations, using very simple arithmetic that a child of eight could use, yet doing this at such a high speed that the total number of operations is of little importance. An analogue computer, on the other hand, is set up, not to do arithmetic, but with an electrical circuit, which *obeys the same equations* as the problem under consideration. So a problem is set on an analogue machine by linking a series of high-gain amplifiers, which can 'step up' or 'invert' voltage values as required to establish circuits.

Consequently, two types of 'input' information are required for operating an analogue computer:

1—The mathematical equations which describe the problem. Various resistors, capacitors and amplifiers are wired up to agree with the equations. These are set on a 'patchboard.'

2—Numerical values for the constants and parameters in the problem. This involves first deciding on a scale of values—for example, five volts could be taken to represent one inch or two ounces, etc—then setting the appropriate voltages on potentiometers for feeding into the machine.



Laporte's new hydrogen peroxide plant started production last October. Prior to this the complete plant had first been tested on the Emiac I analogue computer

Time Scale

One advantage that accrues from the fast speeds at which analogue computers perform calculations is that a computer can work on a 'real' time scale. This means that as soon as data are produced—for instance, on wind tunnel tests or automobile suspension tests—they can be fed into a machine to provide 'on-line' solutions. In fact it is possible to use an analogue computer as part of a 'closed-loop' experimental set-up, where the information provided by the machine would be used to adjust certain controls.

Of course an analogue machine is not always required to function at a 'real' time scale. Any time scale can be used. So, for example, a process whose data were recorded only at hourly intervals, could be simulated on a machine, and the 'model' made to function much more quickly than the actual process. This would be done by

telescoping the time-lag between readings by using some time scale such as 1 : 60.

The results of analogue machine calculations are usually shown graphically on an oscilloscope or drawn by a pen recorder. Ancillary equipment has been developed, however, for translating graphical information on to punched cards.

Checking Plant Design

One example of the new applications being found for analogue computers is the use that was recently made of a machine by a chemical processing company.

In October last year Laporte Industries Ltd began operating a new £2½-million hydrogen peroxide plant at Warrington. However, before the plant was constructed and went 'on stream' —in fact, before the designs had been completed— it had first gone 'on stream' in an analogue machine.

Laporte had reached the design stage where control schemes and vessel sizes had already been determined, when the opportunity arose to make use of the prototype *Emiac I* analogue computer, developed by EMI who were eager to break into the process field with their analogue equipment.

This opportunity was welcomed by Laporte on two counts:

▶ The hydrogen peroxide plant was to be the first of its type in Britain and so there were a number of unknown factors.

▶ In particular, it was an opportunity to glean valuable data on future operating characteristics.

Types of Work

Once they learned of the computer's potentialities, Laporte saw there were four main areas of work the machine could do :

1—Confirming that the capacities of various vessels were adequate for all the expected major flow changes in the process circuit, including starting up and shutting down conditions.

2—Determining the optimum control settings of the plant's automatic controllers. (A simple example of an 'automatic controller' is a thermostat which maintains a level temperature.)

3—Confirming that interaction between various vessels and controllers in the plant would not result in sustained 'hunting' (which occurs when an automatic controller reacts to off-normal conditions and this reaction itself goes beyond the equilibrium point to produce another off-normal reading).

4—Determining if there would be any points of particular sensitivity to oscillatory disturbances.

To provide answers to these four points Laporte, working with a team of EMI engineers and mathematicians, had to devise data about the mass flow of fluids in the process and convert these into computer mathematics.

Thirty-one equations of varying degrees of complexity were worked out for *Emiac I.*

These equations represented conditions that would control the flow at all points in the process. This was the first time that a complete chemical plant was simulated in this way in Britain.

Data for this simulation work—the numerical values for the constants and parameters in the equations—were provided partly from engineering drawings for the plant, and partly from a small pilot plant which had already been built and put into operation.

Advantages Gained

Laporte's experiment of going 'on stream' with an analogue (or mathematical) model of their plant was entirely successful. The investigation showed that no major mistakes had been made either in the design of vessel capacities or the arrangements of controller systems, while a number of minor modifications which improved plant efficiency could be introduced.

Laporte explain that it is extremely difficult to assess the actual economic return from the computer investigation. In fact they prefer to consider it as an 'insurance check' that no serious mistakes had crept into the complete design for the Warrington plant. A design mistake in pipeline capacity or tank capacity could easily have cost tens of thousands of pounds in delays on a plant of this size. Certainly the ability to set the plant's automatic controllers before actually starting up eliminated what is normally a considerable amount of costly experimentation when a plant first starts up production.

Cost

The complete investigation cost the company about £3,500. This figure included hiring time on *Emiac I* and using the services of EMI mathematicians. In fact the consultatory service provided by the mathematicians represented by far the larger slice of the bill. Laporte intimate that with the experience they gained from working with EMI it should be possible in future to undertake a similar computer investigation for about £1,500.

A. D. P. Names & Notes

THE first national conference of computer programming experts was held at Brighton Technical College from April 1 to 3. It was attended by delegates from industry, the universities and technical colleges, and was a working conference on automatic programming, autocoding and compiler techniques for digital computers. One of the main matters discussed was how to reduce the time spent on programming.

There was a huge response to the conference and numbers had to be limited to 120. The director of conference studies was Dr A D Booth, Head of Birkbeck College Computer Laboratory, whose second article for *Automatic Data Processing* begins on page 5. Among the speakers were Mr A E Glennie of the Atomic Weapons Research Establishment, Dr Stanley Gill of Ferranti and Cambridge University, Dr K V Hanford of American International Business Machines, Mr A E Taylor of Remington Rand, and Dr J Ord Smith of the Standard Telephone Company.

Brighton Technical College, incidentally, has bought an £8,000 digital computer designed and built in Dr Booth's laboratory at Birkbeck College. It contains 800 valves and will be used for instructing students in their final year of engineering. Local industry gave £2,000 towards its purchase, the balance being met by a grant from the local authorities.

★

THE Central Electricity Generating Board has placed an order with International Computers and Tabulators Ltd. to rent an ICT *Type 555* electronic calculator. It will be used for stores and cost accounting, mathematical applications and nuclear fuel element calculations. It will be installed in the London headquarters of the Board, which already has a punched card installation consisting of a *Type 550* electronic calculator, five tabulators and ancillary equipment.

The *Type 555* is the most advanced of the range of ICT electronic calculators and provides limited computer facilities with conventional punched card equipment. It is, in fact, often described as a 'plugged program computer,' and was designed primarily for commercial and accounting work, but it has also proved to be 'a powerful and efficient tool for scientific computation,' in the opinion of Mr J E Hailstone, of the Computer Group of the Atomic Energy Research Establishment, Harwell.

★

ELEVEN local authorities and four regional hospital boards, who are ordering or considering ordering an *ICT 555* electronic calculator, have set up a study group to investigate how best this equipment can be applied to their office systems. The group, which has been set up in conjunction with the makers, is modelled on a computer study group set up last year.

The group held its first meeting on February 25 under the chairmanship of Mr L H Bradbury of Derby County Council when the following syllabus was agreed:

1. Technical appreciation of the equipment.
2. Consideration of the problems of organisation and operation involved in the installation and use of such large-scale equipment.
3. Case studies of existing installations in local government and in other fields.
4. Progress reports and exchange of experience.

The group has planned to meet at monthly intervals, first in London (where the calculator is available for demonstration) then later in provincial centres.

★

SOME of the latest products of EMI Electronics Ltd were shown for the first time in North America during an industrial exhibition in New York on March 23.

These included *EMIAC II*, the company's general-purpose analogue computer, which has been specially designed for use on guided weapons, nuclear reactors and other simulation problems. Other exhibits included a new industrial strobo-

scope with the exceptionally high rate of 60,000 flashes per minute and a high light output. A photo-electric probe, photo-head amplifier and light diffuser are built in on this instrument.

★

A 35-foot long exhibition caravan with working demonstrations of pneumatic instruments made by Sunvic Controls Limited is at present touring shipyards in Britain. It has been fitted to show the application of the company's instruments to marine installations.

Demonstrations include systems for automatic control of turbine lubricating oil temperature and furnace fuel oil temperatures. At the end of this month the vehicle leaves for a tour of Holland and Belgium.

★

MR B L HART of the Computer Applications Department of the British company, International Computers and Tabulators Ltd, gave a lecture on " Production Control by Computer " at the University of Delft, on February 27. Mr Hart's lecture was part of a course organised by the Dutch Research Institute of Scientific Management and was attended by senior management executives from a number of European countries.

'Production control' is an aspect of production management. The term is used to designate a complex of functional activities concerned with the provision of information about: —

1. what is to be produced
2. how, when and where it is to be produced
3. how far actual production matches that which was planned
4. the requirements of stocks of productive items necessary to ensure continuity of production with the necessary financial outlay.

The computer is the ideal instrument for carrying out the multitude of calculations on which such information is based and Mr Hart's company has pioneered in one of its own factories what is believed to be the first attempt in the United Kingdom to apply a computer in this way (see *Automatic Data Processing*, March 1959, page 26).

★

TAYLOR WOODROW Construction Ltd have been awarded a contract valued at £200,000 for the construction of a factory and ancillary buildings near Letchworth, Hertfordshire, for International Computers and Tabulators Limited. This is the first phase in the development of a 7¾-acre site.

The work, which began in March, and for which the contract period is 30 weeks, involves the construction of a single-storey factory 450 feet long by 100 feet wide and 14½ feet high, with two single-storey annexes, a boiler house, canteen, loading and despatching bays. The architect is Mr Hugh D Roberts, FRIBA.

★

THE Applications Laboratory of Semiconductors Limited is now installed in its new building adjacent to the Swindon factory. The Laboratory has been specially equipped to provide immediate and detailed design assistance to manufacturers of transistorised equipment. Other responsibilities include the development of transistor application techniques and the preparation of Semiconductors Transistor Application Notes.

★

THE development of automation is one of the themes to be covered by study groups at the BIM Scottish Management Conference at Gleneagles from April 17 to 19. The speaker at the closing dinner will be Sir Cecil M Weir, chairman of International Computers and Tabulators Ltd.

The American fortnightly Computing News *recently published an account by Ray R Reighart II of a computer which he designed and built in nine months. He is convinced he can build one in a shorter time. 'The only thing that takes the time is re-building and re-designing things that do not work.'*

When not building computers Mr Reighart is a pupil at Alliance High School, Alliance, Ohio.

A monthly report prepared by the New York Office of John Diebold and Associates

A Cautious but Healthy Computer Market

There has been a marked trend towards medium-size computers in the past year—and signs of waiting for innovations on machines

THE latest computer census made by the research staff of John Diebold and Associates, Inc shows a 20 percent increase in the use of electronic computers over the number reported in March of last year. The total number of computers in use in the United States is now approximately 7,200. Although the installation rate shows a large increase in the past year, the increase in orders has not been so impressive. Orders of some of the major manufacturers fell off as much as 50 percent during 1958, a recession year. This will be reflected in a decreased rate of deliveries during 1959 and early 1960.

Another factor which may cause a slower rate of installations in the immediate future is the announcement of the transistorized machines, all showing advanced features and a wide range of application. It has been indicated that many potential customers are waiting until these machines will be ready. Initial deliveries of most of these are scheduled for mid-1960. Therefore, the next five years will probably show an early levelling off in the next year and a half, but a substantial increase should be seen in computer deliveries after 1960.

More Data Processing

The current census shows a total of 316 large-scale computer installations. Almost one-third of these have been installed during the past year. These large-scale machines are being used for both scientific and data processing applications. The aeroplane companies were the pioneers in the scientific field and insurance was the earliest industry using these computers to solve some of the paperwork problems. In past years, the majority of the large-scale computers were used for scientific purposes; however, at present, installations of these machines for data processing applications are increasing. This is mainly due to the fact that there have been improvements in design; features have been provided which facilitate more efficient use of the machines for data processing applications.

With the advent of the newly announced transistorized machines, the large-scale computer market will continue to grow in the data processing area. These new machines have specific features for data processing problems, but may also be used effectively for scientific computation. A wide range in size is covered by these new machines. At present, there is a clear-cut line between medium and large-scale machines; however, the new computer models overlap these two classifications. Since they are modular in design, the same basic system may be expanded to fill the requirements of the user.

Double Systems

Since the new systems are equally capable in both the data processing and scientific areas, many companies may in the future be using one system for both types of problems. Expansion of a single system will provide the capacity for the larger volume. Features on some of the new systems provide automatic control for running two problems simultaneously. The combination of a scientific and data processing problem makes for efficient use of the entire system. The computer can be working on the scientific computation while independent tape and input-output operations are being performed for the data processing job. With these capacities and capabilities the new systems will be able to handle the work now being performed by two different systems.

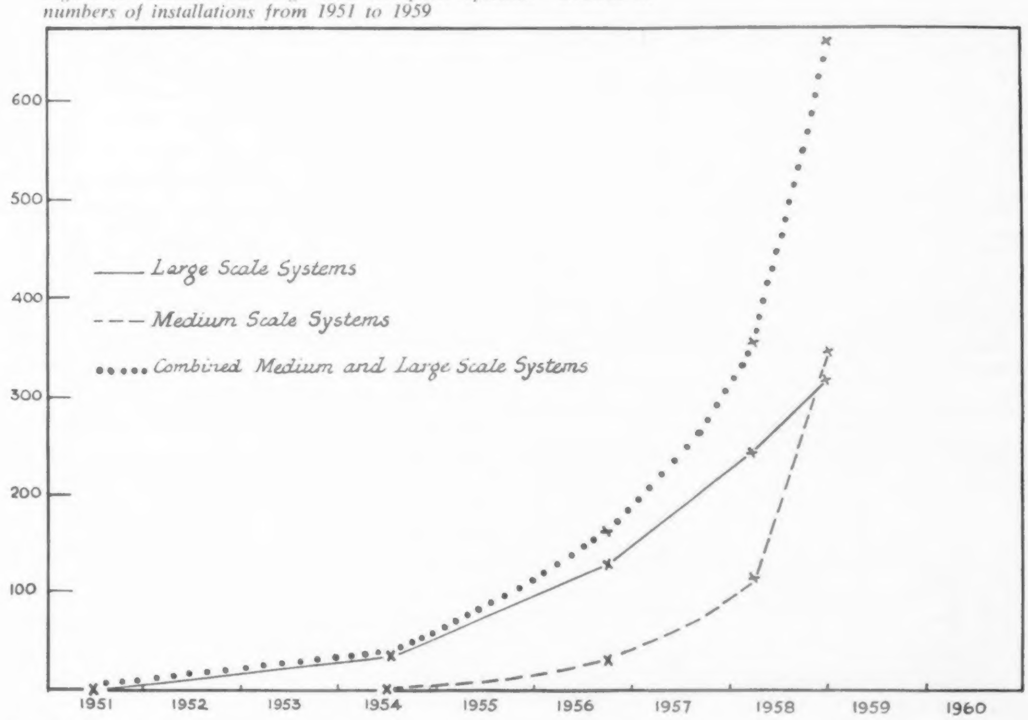
The accompanying graph (fig. I) showing the growth of the number of large scale computer installations shows an increasing rate of installations in the past two years. It is interesting to compare the growth of the large and medium scale market. During 1957, large scale computers were being installed at a greater rate than the medium; however, in 1958 the medium scale computers showed a considerably higher increase than the large scale. The sharp increase in the medium scale market in 1958 is mainly due to the *IBM 650*. IBM started delivery of the tape units for the *650* in the Spring of 1958. Therefore, all IBM's medium scale computers have been installed in the past year. Many card machines were converted to tape systems, so that the total number of card *650* installations (classified as a small computer) shows a decrease during the same period. Also in the medium scale class, Remington Rand got into full swing with their File-Computer and delivered approximately 75 during 1958. The high increase in medium scale computer installations has been largely due to the increased application of computers to business data processing activities.

Small Computers

The small scale computer class has two groups. One group is made up of the scientific computers such as the *LGP-30* and the Bendix *G-15*. The second group is composed of more expensive machines which may be expanded into medium scale data processing systems. These are the *IBM 650*, *Burroughs 205* and the *Alwac III-E*. The *IBM 305* is a small scale machine but is used for business applications in most cases.

The greatest growth in this class has been shown by the small scientific machines and IBM's *305*.

Figure I: Medium and large scale computer systems. Growth in numbers of installations from 1951 to 1959



Large-Scale General Purpose Digital Computer Systems			
Manufacturer	*Computer*	*Delivered*	*On Order*
Burroughs	Burroughs 220	4	41
Datamatic	Datamatic 1000	5	3
IBM	701**	9	0
	702**	11	0
	704	80*	—
	705	95*	—
	709	0	—
	7070	0	—
National Cash Register Co.	304	0	7
Philco	Transac S-2000	1	—
RCA***	Bizmac I**	2	0
	Bizmac II	3	1
	501	1	20*
Remington Rand	1101, 1102**	10*	0
	1103, 1103A	25*	0
	1105	1*	—
	Univac I	60*	—
	Univac II	9*	—
Total Large Scale Computers		316	

* *Unofficial estimate.* ** *No longer in production.*
*** *Bizmac totals are number of installations not numbers of computers.*

Figure IIa

Medium Scale General Purpose Digital Computer Systems			
Manufacturer	*Computer*	*Delivered*	*On Order*
Alwac	Alwac III-E w/tapes	4	8*
Bendix	G-15 w/tapes	45	—
Burroughs	205 w/tapes	81	22
IBM	650 w/tapes and/or Ramac	120*	—
Remington Rand	Univac File-Computer O	26*	—
	Univac File-Computer I	59*	—
Underwood	Elecom Series**	13	0
Total Medium Scale Computers		348	

* *Unofficial estimate.* ** *No longer in production.*

Figure IIIa

Small Scale General Purpose Digital Computer Systems			
Manufacturer	*Computer*	*Delivered*	*On Order*
Alwac	Alwac II & III**	8	0
	Alwac III-E *(No Tapes)*	30	8*
Bendix	G-15 *(No Tapes)*	125	—
Burroughs	205 (no tapes)	19	9
IBM	650 (card)	680*	—
	305 Ramac	250*	—
Monroe Calculating Machine Co.	Monrobot III, V, VI**	11	0
National Cash Register Co.	102**	30	0
J. B. Rea	Readix**	4*	0
Royal McBee	LGP-30	213	18
Total Small Scale Computers		1,370	

* *Unofficial estimate.* ** *No longer in production.*

Figure IIb

Miscellaneous Digital Computers			
Manufacturer	*Computer*	*Delivered*	*On Order*
Burroughs	E101	175	23
IBM	604	3,624*	—
	607	475*	—
	608	1*	—
	610	40*	—
	CPC**	60*	—
Monroe Calculating Machine Company	Monrobot IX	1	50*
Remington Rand	Univac 60 & 120	776	—
Underwood	100	14	15*
Total Miscellaneous Computers		5,166	

* *Unofficial estimate.* ** *No longer in production.*

Figure IIIb

The market for the scientific machines is not affected by the large scale scientific machines, for the small computers are generally used by those who do not have the volume which would require a large system. In many cases, the small machines are used in conjunction with a large scale system for preliminary analyses and small problems which are not worth putting on the larger machines. The ease of operation and low cost of these machines have made them very attractive to many engineering and research departments.

Of the other computers in the small scale class, the *IBM 305* has shown a substantial increase in installations. This is another indication of the increased use of electronic equipment for business applications and in this case for the small scale applications. However, the use of small scale *IBM 650's* and *Burroughs 205's* has not increased. This has been a result of conversion or installation of expanded systems to provide magnetic tape and file processing capabilities. Therefore, the increase in the use of these machines is found in the medium scale class rather than here.

The total picture of the small scale computers shown in the graph (fig. IV) does show a large increase in the use of this class of computer. The small computer utilization has actually increased more than is indicated on the graph. There have been a number of conversions of small scale *IBM 650's* and *Burroughs 205's* to medium scale systems by the additions of magnetic tape equipment. Therefore, this has caused a decrease in the small scale class which shows up as an increase in the medium scale class. In the small scale class, however, the reduction in these two machines reduces the increase in the installations of small scientific machines and IBM's *305*.

Punched Cards

In order to round up the computer census, the punched card computers and externally programmed electronic computers are shown in the Miscellaneous class. The use of punched card computers began considerably earlier than the computer systems already discussed. Nevertheless, there is a continuing demand for this equipment. The censuses for the past three years have shown approximately 700 new installations each year. This market will probably not be affected substantially by the use of larger computers because as users of the equipment who are large enough take the step to the data processing systems new customers will be making their first step into electronic punched card systems.

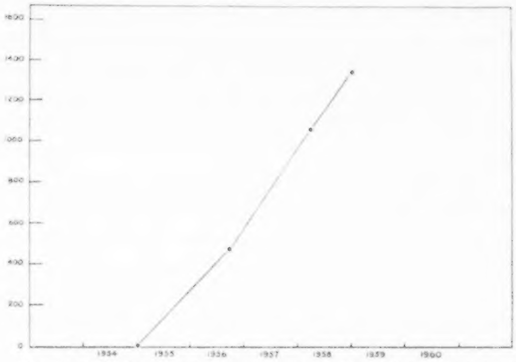
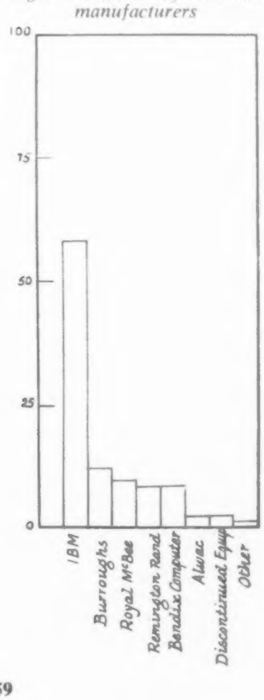


Figure IV: Small scale computers. Growth in numbers of installations from 1954 to 1959

As the use of electronic computers and data processing equipment increases, it is interesting to analyze how the various manufacturers progress in comparison with each other. The charts shown here are based on the census figures. It is clear that IBM is the uncontested leader in the field in the United States. Chart V shows the percentage of the total computer installations held by each of the manufacturers. (This does not include punched card computer installations). This representation can be somewhat misleading because it is not indicative of dollar volume.

Figure V: Total computer installations (excluding miscellaneous punched - card computers) showing percentages installed by various manufacturers



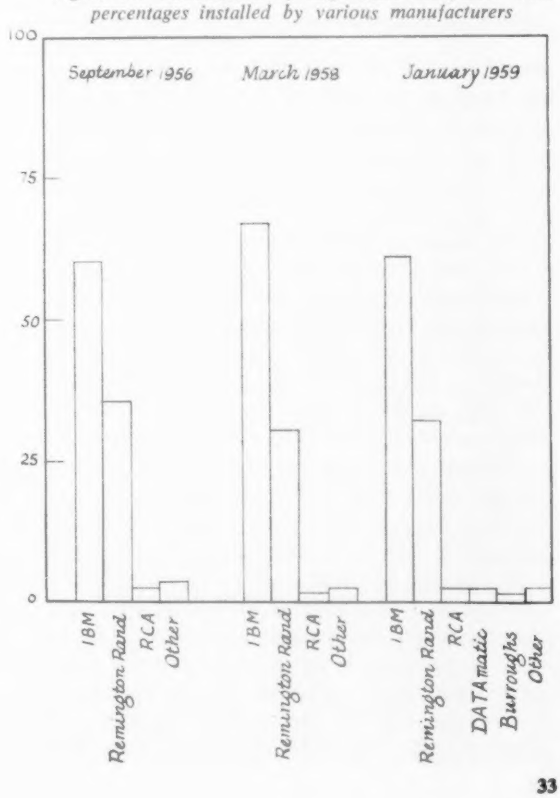
Such companies as IBM, Remington Rand and Burroughs have a full line of equipment from small scale to large scale machines. Royal McBee Corporation has a large number of installations: however, theirs is a small machine and therefore they do not hold anywhere near nine percent of the dollar volume. The same is true of Bendix Computer Division. Included in 'Other' are such machines as Minneapolis-Honeywell's *DATA-matic 1,000*, RCA's *Bismac* and *501*, and Philco's Transac *S-2,000*. These are all large scale machines and dollarwise one installation may be as much as 15 times the value of a small one.

The charts showing large, medium and small scale markets separately give a truer picture of the comparative standings of the manufacturers. It is interesting to note that the market is beginning to be a little more widespread among the different manufacturers.

Increased Orders

In the large scale computer market, IBM and Remington Rand are the major producers. Although IBM holds a larger number of installations at present, during the past year,

Figure VI: Installations of large scale computers with percentages installed by various manufacturers



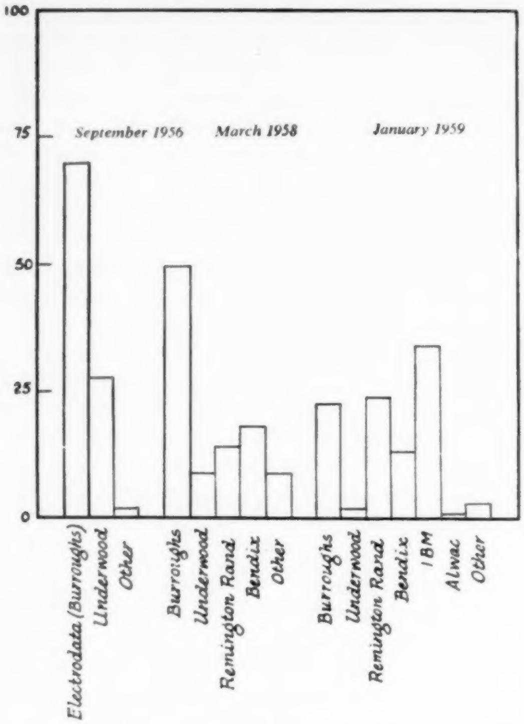


Figure VII: Installations of medium scale computers, showing percentages installed by various manufacturers

Remington Rand has installed large scale machines at the same rate as IBM. Burroughs has just started delivering its *220* and with 41 on order, the coming year should show an increase in their installations. Other manufacturers are expected to show increases also. By the end of 1960, RCA, Minneapolis-Honeywell, NCR and Philco expect to have installed some of their new transistorized machines. Although more manufacturers are active in the large scale market, there is no doubt that IBM will retain its leading position. IBM's *7070*, which is comparable to the new machines introduced to the market, already shows a substantial number of orders.

Although the new group of large scale systems are somewhat more expensive than the present medium scale systems being installed, they are expected to take over a large part of the medium scale market. Medium scale machines were first available in 1954 and until 1957 there were very few of these systems being manufactured. Underwood dropped out of the market about that time. Electrodata, now a division of the Burroughs Corporation, held the lead in this class with their *Datatron 205*, until IBM began delivering their tape *650's* in 1958. At the present time, IBM, Remington Rand and Burroughs are the major contenders for the market. In the future, it will be difficult to separate this group from large scale machines. Rather, it will be medium system and large scale systems of the same basic machines.

The introduction of new machines has had an effect on the sale of the early computer models. At the present time, many of the older models are being offered at reduced prices. This is true of some of IBM's early *700* series machines and Remington Rand's *Univac I*. Burroughs also has a few early *205's* which do not have the features of the later models. These are being offered at reduced rates. In the Autumn of 1958, IBM announced the *Series 50* punched card line. This is actually some of the older models which have been modified to operate at slower speeds and which are available at low rental rates.

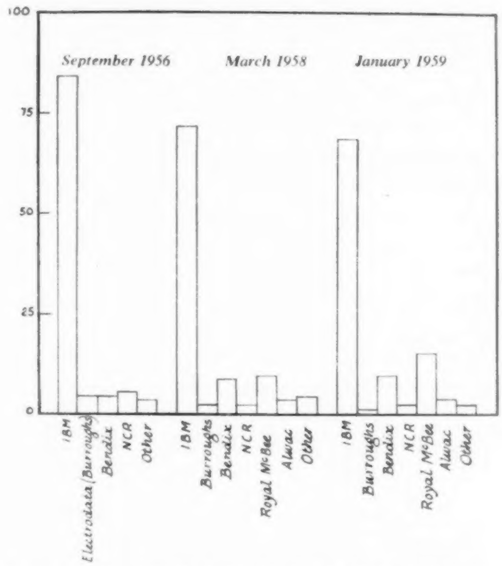


Figure VIII: Installations of small scale computers: percentages by manufacturers

COMPUTER CLASSIFICATIONS

LARGE SCALE: The system uses magnetic tapes and the computer operates at internal speeds which are measured in microseconds.

MEDIUM SCALE: The system uses magnetic tapes and the computer operates at internal speeds which are measured in milliseconds.

SMALL SCALE: The system does not use magnetic tapes and the computer is internally programmed.

MISCELLANEOUS COMPUTERS: Card calculators and other machines which do not fall into one of the above systems classifications are placed in this class.

The Birth and Growth of a Data Processing Service

by PHILIP MARCHAND

The computer services developed by Leo Computers Ltd began with an attempt to solve office efficiency problems at J Lyons and Company

THE background of the several computer manufacturers who are now selling in the British market is varied and surprising. They include large electrical engineering firms, manufacturers of punched card equipment, accounting machines and telecommunications equipment, and J Lyons and Company, through their subsidiary, LEO Computers Ltd. LEO Computers' background is surprising in this respect: Lyons did not sell electrical or business equipment but were concerned with office efficiency in their extensive catering business.

The post-war Lyons company, aware of the increasing cost of their clerical procedures, were on the look-out for all-round improvements. In 1947 the company sent a team of two senior executives to study American methods of increasing office productivity. The executives had no particular brief to study computers (whose applications at the time were limited to scientific and military work) but nevertheless visited the Harvard University 'electronic brain.' Impressed by what they saw and quick to realise that computers could eventually be used for business applications, the study team put two alternatives to the management when they reported back; either Lyons could wait until 'commercial' computers became available or the company could come in at the development stage, and themselves evolve equipment tailor-made to suit their own requirements.

Started in 1949

With assistance from the Cambridge scientists who built the early *Edsac* machine, Lyons started to build a business computer in 1949. By 1951 it was completed and was first put to work on mathematical calculations. However, the aim was that the computer should be made to do clerical work, and early in the development stage executives from the Organisation and Methods department were seconded to plan putting work on to the computer. In December 1953, the Lyons electronic office *(LEO)* began doing clerical work, in particular, working out the payroll for the Cadby Hall bakeries.

From the start, other organisations showed an interest in *LEO*, and as Lyons had surplus capacity on their machine, they were able to sell time on it. For example, the Institute of Actuaries, the Meteorological Office and the Ordnance Board were among the first clients of the Cadby Hall computer. Lyons in fact were the first company in Britain to get a computer 'centre' going.

Most of the early clients hired the computer for mathematical calculations. For instance, the Ordnance Board used *LEO* to work out ballistics

Mr David Caminer, Manager of the Consultancy and Marketing Division of Leo Computers Limited

tables, and work done for the National Coal Board involved trying to correlate data about certain types of employment with data relating to certain diseases.

Mathematical work — engineering calculations mostly — was also done for several aircraft companies such as Bristol Aircraft, Handley Page and Armstrong Whitworth. *LEO* made, too, a substantial contribution to the development of guided missiles in this country.

Certainly the catalogue of the scientific, mathematical and statistical jobs that have been done to date at Cadby Hall is impressive and varied. The scope of the work provided Lyons, who in almost every case did the programming for their client, with a backlog of useful experience in scientific computation.

Ford Payroll

In the early years much of the time was available precisely because the special developments that were necessary before *LEO* would be ready to tackle large-scale clerical work had not yet been completed. However, in 1953 the required links with rapid input and output equipment were completed, and in the following year Lyons achieved a major breakthrough when the Cadby Hall computer began processing the Ford Motor Company's Dagenham payroll of 23,000 employees. Clerical data processing is, in general, a much more rewarding field for a computer centre than the scientific computation field, and to do regular, week-by-week work on a service basis for outside organisations is no doubt the aim of several of the centres that have been set up by the computer manufacturers.

After 1954 surplus capacity on the original *LEO* began to be whittled down as Lyons put more of their own work on to the computer. Today, the computer does a regular weekly payroll calculation for some 18,000 Lyons employees throughout Britain. In addition, it turns out for the company delivery information for goods to be despatched daily to 160 London teashops, details about stocks and when to replenish for the company's tea business, and a host of information for invoices, sales statistics and cost accounting. Consumer preference tabulations are another large weekly task carried out for the parent company.

Seven-day Week

An analysis of work being done at Cadby Hall published in the *Financial Times* early in 1957 showed that *LEO* was working a 135-hour week with some 33 additional hours spent on maintenance and testing; this, in fact, added up to a 24-hour day seven times a week.

Lyons followed up their success with their electronic office by giving their engineers the go-ahead to develop a second computer; they also set up an independent company, LEO Computers Limited, to handle all computer activities.

By the end of 1957 the engineers had built *LEO II*—a more powerful and faster computer—and LEO Computers had found a headquarters, and a home for the new machine, at Elms House in Brook Green, London. The new machine was designed as a prototype for sale as well as for service work and several are now in operation.

The Service

LEO Computers now run two centres, at Cadby Hall and at Elms House. And a third machine, equipped with magnetic tapes and fast printers, is now being installed in Bayswater.

However, the company do not merely hire out time on their machines; they also run a complete consultancy service which will co-operate with outside managements to do the systems studies necessary before clerical work can be put on a computer; and they offer, and are generally asked, to do the programming for their clients, at least for the first job undertaken in each case.

Also important for clerical work is the ancillary equipment that LEO Computers put at the disposal of clients. For example, a punched card reader which activates an electric typewriter means that a computer's output—using punched cards as the medium—can be immediately translated into ordinary language and set out in sequence on paper. Alternatively, the electric typewriter can be made to produce an offset litho master so that copies can be run off and circulated to executives.

The Elms House centre also makes use of a Xerography machine which produces masters for duplicating, using a dry photographing process. When a tabulator or high-speed printer is linked to the machine for ' on-line ' printing, Xerographic masters can be made from the continuous sheets of data that emerge from the printer. In addition to copying or photographing the Xerographic machine can also reduce in size what is being copied. Thus when the computer is compiling tables of figures, page masters in reduced type can be made from the tabulator roll. The tables can then be presented in book form, cutting out the need to set up in type and print the tables in the conventional manner.

Library of Programmes

One facility offered to clients with engineering or mathematical problems is the large number of programmes that have been written by the centres. Often, with engineering problems, a programme that has been written to solve calculations for one company will suit the needs of another. By using an existing programme a client can be saved considerable time and expense.

What the Centres Do

The pattern of work has changed from the scientific and mathematical calculations which

Programmers discussing an industrial problem at Elms House, one of the Leo centres

Operators perforate tape in preparation for LEO 1

were done on the first *LEO*. After taking on the Ford payroll in 1954, LEO Computers have contracted to do other payroll jobs. The Greenwich Borough Council now has its payroll calculations for over 1,000 employees processed by *LEO II*. Kodak also send payroll data—in this case for some 7,500 employees—to Elms House. Tate and Lyle have their Plaistow refinery payroll produced by *LEO II*.

Many more hours are now spent on business jobs than on scientific calculations. These include weekly stock control jobs for the Ever Ready Company and others, and annual stock valuation work for Sanderson Fabrics.

A variation of processing data is a calculation that is done each week for a firm of stockbrokers dealing in gilt-edged stock. *LEO II* is being used to calculate the yields obtained from some 600 fixed-interest stocks at current prices. The clients receive results on masters so that they can despatch duplicated copies to their clients without delay.

Recently, increasing business for the centres has come from the insurance companies. Eagle Star, Alliance, Atlas, the Prudential and the Legal and General all feature on *LEO II's* work schedule. Making quotations for, and renewing and valuing, group pension schemes forms a particularly large part of this area of work.

Buying or hiring time on *LEO II* for a straightforward scientific job costs about £50 per hour. However, LEO explain that when they are called in to do a complete job, the rate of charge will normally be quoted on the basis of the appropriate unit of the work to be done. Thus, payroll charges are based upon a cost per employee per week, or a public utility accounting job on the basis of a cost per customer to be billed, or a group pension scheme on the cost per person for whom provision has to be made. By this means, the complete onus of operating the computer efficiently on the work rests entirely on LEO Computers' team of operators. Only when scientific work with the highest security considerations is being carried out do the *LEO* operators hand over to employees of the client company.

In addition to the operator charge, LEO also charge for their programming services, though where the work is repetitive they are prepared to spread those charges, as a surcharge of the operating cost, over an agreed period. The more sizeable the load on the job the lower, of course, will be the proportion of programming costs to the total. For example, though it took a year to prepare the programmes for the distancing job done for the British Transport Commission, the programming cost for this, the largest single job to be tackled by a computer, was only a very low proportion of the over-all cost.

A stage-by-stage explanation of how HM Stationery Office studied computers, and then ordered and prepared for a machine

Systematic Planning for a Computer

by V H MORLEY

IN June 1958, HM Stationery Office took delivery of a *Hec 1201* computer to take over, stage by stage, the main financial accounting, stock control, and bill-paying procedures. The type of conversion being carried out is from conventional punched card equipment to punched card computer. Before describing our experience in this venture I will by way of introduction make a brief mention of the activities of HM Stationery Office.

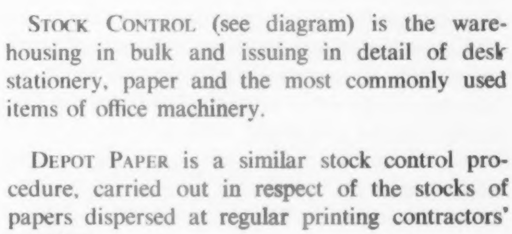
HM Stationery Office is the central purchaser and supplier of desk stationery, paper, office requisites and office machinery to all Government offices, at home and abroad, and including the Defence Services. It is responsible for the printing and publishing of over 6,000 Government publications a year with over £1 million in sales. The head of HM Stationery Office is the Controller, who, by Royal letters patent, is the Queen's Printer of Acts of Parliament, personal holder of all the Crown's copyright, and Editor of the *London Gazette*.

Feasibility Study

Extent of Review

The feasibility study occupied the first six months of 1956. The scope of the review was to examine briefly the existing punched card procedures and, in addition, the payroll, to determine which were likely to become suitable computer applications, to decide on the machine to be ordered, and to make an economic appraisal to justify the change.

The punched card installation dates from 1927, and comprises 25 punches and verifiers, six sorters, two reproducers, two collators, one electronic multiplier, seven tabulators and one balancing tabulator. It carries out five main office procedures, as illustrated in the diagram below.



STOCK CONTROL (see diagram) is the warehousing in bulk and issuing in detail of desk stationery, paper and the most commonly used items of office machinery.

DEPOT PAPER is a similar stock control procedure, carried out in respect of the stocks of papers dispersed at regular printing contractors' premises.

BILL PAYING is payment to contractors for goods and services rendered.

PRINTING COSTS is the costing of printing and duplicating in our own works.

These four procedures represent the main sources of expenditure, and the detail punched cards raised from source documents, after being used in each procedure, are accumulated into the financial accounting procedure. This consists of two parts, the statistical distribution of expenditure under Vote Subheads against Government departments who receive their stationery on a free basis, and the rendering of accounts for goods and services supplied to those Departments who for various reasons are not entitled to free supply. A short review of these five procedures, and of payroll, which was decentralised on desk accounting and manual systems, showed that conversion to a computer system would bring worthwhile improvements.

Advantages of Computerisation

Discussions with representatives of user Divisions established that more and earlier information was required; investigation into the capabilities of computers suggested that their storage capacity and automatic programming facility would offer prospects of obtaining these advantages. Users also desired improved accuracy of results in tabulations, and here again the ability to programme arithmetical checks into the computer offered an improvement. Our own experience of the electronic multiplier had already indicated that electronic processing was in any case more accurate and reliable than mechanical calculation. Investigation also revealed the possibility of the solution of management problems from new data.

Economic Justification

Risk of early obsolescence in a fast-developing field, the opinion that a manufacturer might maintain a hired machine better than one sold outright, and the free provision of spare parts within such a hiring agreement, all pointed to the desirability of rental against purchase. A broad estimate of the likely cost was built on the hire charge of the computer; and savings expected from the surrender of staff and conventional equipment in the installation were calculated. The resultant balance sheet showed the definite prospect of a much better system for about the same running cost. In addition, it was considered that a saving could be made in the user Divisions, representing an annual financial saving of one and a half times the computer's annual hire charge.

Planning the Conversion

After due consideration it was decided to plan the converson of work in a practical manner by making piecemeal transfers of procedures, leaving a greater degree of integration to develop as experience was gained. The planning of a fully integrated system at the outset appeared too large an undertaking, with the danger that it would take too long in investigation time and would increase staff costs at the planning stage beyond acceptable proportions.

Choice of a Machine

A number of factors were taken into account in selecting the computer.

Size and Type

HM Stationery Office has several repetitive procedures, each of no great volume, and an estimate of the work load indicated the requirement of a medium-sized computer, working one or two shifts, whilst the variety of work necessitated a general-purpose machine.

Speed and Storage Capacity

Bearing in mind that these are the highest costs in the logical design of a computer it was essential to limit both to our true needs, at the same time ensuring rapidity of access to stored data. Also, it was felt that one level of storage would be enough to cope with, in this first venture.

Order Code

Because of inexperience in planning and programming we looked for a relatively simple order code with a range of automatic functions.

Input and Output

Familiarity with punched cards had given us considerable experience of card design, coding and the general organisation of work, and we preferred to preserve this accumulated knowledge rather than to change over to another, untried method of input and output. Reports on other methods at that time certainly did nothing to encourage us to abandon punched cards. We were well aware of their advantages; they offered a fully visible

H M S O took delivery of their Hec 1201 machine in June 1958, and to date have written nine programmes for it

record, easily referred to, read and amended, and new input data would be mechanically sorted away from the computer on cheap ancillary machines. The on-line tabulator offered 100 alpha/numerical print wheels, sufficient for our printing needs, and the attached summary punch could produce cards as the main external store.

Systems Study

The order for a computer was placed in July, 1956, and the systems study then began. Two assistants helped with planning; one had some very useful punched card knowledge and the other was seconded from the departmental section; his eight years' experience of systems investigation proved of immediate value.

The planners were given an 18 months' start over the programmers. Before systems planning could begin it was necessary to devote several weeks to the education of executives in the user Divisions, to enable them to appreciate the capabilities and limitations of the computer.

In planning a computer system it was found necessary to introduce completely new thinking, without regard to what had happened before. This meant getting accurate answers to the questions 'What is it you want to control?' and 'What information do you need in order to do so?' before the shape of the system could be envisaged. Inevitably this thinking afresh gave rise to suggested policy changes, and it was found expedient to pull these out first, write them up, and submit them for decision before going too far into formulating the system.

Means were sought of making fundamental changes in the methods of recording, to expedite the processing of information and to avoid duplication of effort. Some information was found to be usable in other operations without further coding or conversion. Investigation to complete detail was necessary to ensure that the system covered all possible conditions and exceptions. Prime documents were designed, and decisions made on the method of transfer of the information from the documents, the information to be processed and the reports to be produced.

Benefits of a Computer

As planning progressed we became more aware of the advantages the computer offers over conventional punched card equipment. Division provides a wider range of calculations; storage capacity on the magnetic drum facilitates accumulations for analyses; testing allows minor decision making, printing by exception and management by forecast; long automatic programmes needing less runs of input cards, offer speed and earlier results; the printed output provides more significant, more detailed and more selective information from the available data.

Progress of Planning

Planning has been found to be very time-consuming. The financial accounting procedure now on the computer has taken 40 man-months.

Stock control has so far taken 12 man-months and payroll seven; both systems are still in their early stages. Management is informed monthly of progress made; and staff representatives are also kept informed.

Improvements in Procedure

The main improvements we have either obtained or are hoping to obtain are summarised below.

Financial Accounting

(a) Statistical Analysis

HM Stationery Office spends about £20 million each year, offset by receipts of approximately £5½ million. To facilitate control of this expenditure the Accounting Officer is furnished with statistical distributions of expenditure with a two-way analysis, by the Government Departments incurring expenditure and by the Vote Subheads, e.g. paper, printing, binding, etc, under which that expenditure is incurred.

Mainly because the computer can cope with accumulations throughout the year, the number of printed returns has been cut from six to four and, furthermore, three of these are produced in summary card form as by-products of the fourth, ready for off-line listing. The previous production time of 48 hours a week has been cut to one-quarter and the returns are therefore available 10 days earlier. Statistics have been produced in the most convenient form for the users, thereby eliminating all clerical analysis and annotation of returns. Only information on which executive action is taken is printed.

(b) Claims Recovery

Twenty-five thousand accounts are presented each year. Compilation of these accounts on the computer will produce more informative and more accurate accounts, and will provide them more quickly and more economically. It is calculated that the computer will produce in one morning the same number of accounts as was compiled manually by seven clerks and one typist in six weeks.

Accounts will be presented anything up to 10 weeks earlier than before and, following so soon after the event, are expected to reduce the number of queries that arise. The manual system for ensuring that the money comes in, accounting for it when it does, and analysing it, has also been computerised, and punched card files are being substituted for all books of account, journals and ledgers.

Stock Control

Approximately 2,700 items, to a value of £2 million, are held on stock in London, Manchester, Bristol, Edinburgh and Belfast. There are about 130,000 transactions a month, with a value of £500,000.

A fully automatic provisioning system, based on forward planning, with control centralised in Headquarters, is intended to reduce stocks, regularly review items procured and stocked, and provide management control information to reconcile orders placed with financial allocation. The advantages being sought are:

1. Saving of warehouse space and staff, and reduction of capital tied up in stocks, as a result of an improved stock maintenance formula.
2. Elimination of stock items with little or no movement.
3. Conversion to stock of those specially purchased items which are inexpensive and in regular demand.
4. Earlier information and re-ordering action is necessary.
5. A commitments register to assist planning, providing full details of all outstanding orders and of estimated future requirements.

Payroll

The size of the payroll is small—6,700—but it is complicated by the dispersal of staff in 40 locations and by its diversity, a quarter being salaried and the remainder comprising clerical and industrial grades. The production of a payroll is already a proven computer application and so the approach has been to surround the computer with a system that will simplify associated work. The system is being planned to provide, in addition to the payroll, advice slips, bank lists, income tax returns, and a number of ancillary calculations previously manually compiled.

Bill-paying and Costing

The intention is to streamline the procedures, improve accounting and make available more

information at an earlier stage for management control.

Steps in Conversion

Planning for the Machine

Throughout planning, the necessity has been brought home to us to keep the capacity of the computer in mind so as to obtain optimum balance between speed and storage space. Too much internal storage of data, for instance, takes up programme instruction space and can necessitate more than one processing run. In editing input we have established recognised abbreviations for names and addresses of employees, banks and contractors, to confine them to the 24 positions of the alphabetical storage unit attached to the tabulator, and thus to avoid reading into the computer.

Stages of Conversion

It has been found possible to convert in two distinct stages. New clerical procedures have been introduced, records have been converted, and redesigned documents and cards and revised tabulations have all been brought into use well in advance. Experience has taught us to make these preliminary changes as early as possible during this first stage. Then maximum concentration can later be directed towards the second phase of putting the work on the computer.

Sequence of Conversion

The most straightforward application, financial accounting, was chosen first so that we could become familiar with the progressing and operating of the machine. The experience thus gained is proving of great benefit in planning the major projects, stores control and payroll. Only the first procedure was made ready in time for the machine's installation, ensuring that spare capacity has been available for overcoming early teething troubles and for 'debugging' further programmes.

Parallel Running

New procedures have been run in parallel with the old until the user was satisfied, and this has sometimes needed a temporary increase of staff. Care was taken to ensure that stocks of existing stationery would be adequate until the conversion was complete. Operating instructions and programmes were revised in the light of the trial run, although in fact most of the rewriting was not a result of inadequate or inaccurate planning, but due to management's new awareness of the computer's possibilities.

Staff Selection and Training

Programmers

After trials of various personnel it was decided to recruit programmers from the Executive Officer grade. It was felt that their level of academic attainment (GCE advanced) would ensure complete absorption of programming techniques, and their experience of office routines would enable them to understand new procedures.

Thirty Executive Officers, who from their general performance, mathematical background, age and temperament appeared to be potential programmers, were given the opportunity of applying for the three posts available. Fifteen volunteered and were given a special aptitude test, the results of which were taken into consideration in making the final selection. (Subsequent experience has shown that the test did give a very reliable indication of relative merit).

This selection took place during August 1957, and training proceeded during the following three months. It included an introduction to the existing punched card installation and attendance at the manufacturer's five weeks' residential programming course. The completion of their training was so arranged that the programmers could start writing programmes without delay.

Operators

The operator was selected from the existing installation on the grounds of her general machine operating experience and her aptitude for punched card work, and her training coincided with the computer's delivery. A second operator was trained so that the lunch break could be covered, and then a third as reserve to the other two. The machine room supervisor was given a higher degree of training, including a programming course.

Programming

Volume

The task of programming has been found to be complex and very time-consuming. At first the planners, from their investigation report and office procedure charts, drew up machine flow charts,

and the programmers wrote their programmes from these. After the programmers had acquired some experience of designing programmes, they preferred to draw up their own flow charts. Continuous employment on programming and the use of advanced programming techniques enables them to envisage the shape of their programmes better than the planners, whose knowledge of programming is theoretical rather than practical.

Some attempt at optimisation has been found worth while, but care must be taken that the ultimate advantage to be gained justifies the effort involved. The programmers also design charts for the operating switches and plugboards on the gang punch and tabulator, and draw up machine operating instructions including action to be taken at programmed stops.

The nine programmes so far written have varied from 100 to 550 steps, and the average speed of writing is two steps an hour, including all time spent on flow chart design, devising the programme, arranging input, conversion and storage, encoding, optimisation and plugboard layout.

Controls and Checks

Our aim is to include as much programmed checking as storage space and programme time will allow. Generally, internal checks have been confined to arithmetical accuracy, and control checks of accumulations have been made externally to save computer time. Input is read in twice and compared on the computer before processing begins; it is also aggregated and compared with a pre-list total.

Organisation

Vertical division of work, with the senior programmer co-ordinating the whole, is preferred. A programmer works on a programme throughout; having designed it and acquired a thorough grasp of the requirements, he can comparatively simply and quickly encode the programme. There seems to be no advantage to be gained from a horizontal division to separate coding from the construction of the flow chart. The loss of coding time to the more senior programmer would be more than offset by the time taken in explaining the programme to the coder.

Programme Testing

Programmes have been tested and proved with little difficulty, only minor programming faults needing 'debugging' as a rule. One instance of programme susceptibility occurred when the machine could only be made to work by the substitution of an alternative combination of functions. Use was made of the demonstration machine at the manufacturer's computer centre on a number of occasions, and this enabled programmes to be proved in readiness for the computer's delivery.

A week's testing was carried out on our own machine at the factory just before it was despatched. Apart from this general testing, continual job checks are carried out. The programmers have drawn up a test pack of cards for each programme, to enable the operator to check the machine before each run is started.

Throughout programme writing and testing, valuable assistance and guidance has been received from the manufacturer. A very useful library of subroutines and an automatic programming routine have also been provided.

Programme Review

A regular review of all programmes has been initiated to keep up to date with changes in rules and practice. Unexpected increases in quantity maxima are also detected and dealt with.

Administrative Arrangements

Stationery and Cards

The input and output cards, printed stationery and carbon paper were designed particularly for the computer and were ordered in good time. Four months' delivery time was necessary. The supply of binders was arranged for housing printed reports.

Equipment

A dual speed form feed was ordered, to produce, simultaneously, complete documents (invoices) on a fast moving feed and smaller documents on a slow feed, as well as additional metal card storage cabinets.

Accommodation

Suitable adjacent rooms for the computer, programmers, engineer and planners were selected and prepared well in advance. Siting of the computer was determined by the floor loading, the heavier units, the electronic unit (25 cwts) and the tabulator (23 cwts) being positioned

immediately over supporting girders. Oak spreaders four inches deep were ordered to spread the load more evenly.

The space allocated to the computer room was 650 square feet, which has since been found adequate. Good natural lighting was supplemented by fluorescent tube lighting. Ample windows on two sides of the room ensured airy and well ventilated conditions. This, together with siting in a clean area of the building, also ensured freedom from dust.

Escape Routine

Alternative procedures, sufficient to produce the working documents required, are being planned on the electronic multiplier and type *902* tabulators. Analyses and accumulations will be brought up to date on the computer when it becomes available after breakdown.

Staff Redundancy

Staff savings are not expected to cause redundancy. The length of planning time has provided a two-year warning, and recruitment is being regulated to ensure that redundancy is covered by normal wastage.

Collaboration

Throughout the planning stage, the requirements of others have been sought and met. Auditors, for example, were brought in from the earliest stages and given every opportunity to advise on the proposed reorganisation of duties and new computer procedures.

The requirements of the Inland Revenue on PAYE statements and records are not overlooked. The cashier is being consulted on the style of note and coin analysis to be used.

The Machine's Performance

The mathematical accuracy of the computer is usually good, errors normally occurring only when the machine develops an operating fault, which can be detected by programmed checks. Occasionally, however, errors have slipped through these checks for no apparent reason and external reconciliation checks have then to be relied on.

The time taken up by breakdowns has varied from 21 percent to eight percent. Present indications are that this will improve.

Routine maintenance has occupied 16 percent and the highest production obtained so far on a single shift basis is 66 percent. This figure has been showing gradual improvement and the aim is to increase to 80 percent.

Summary

Nine months' operating has so far confirmed the advantages to be expected from converting office procedures on to a computer. Earlier, more complete and more accurate statistics are becoming available. Several clerical staff have already been surrendered and larger savings are expected. At the same time the type of investigation into organisation and methods, which computerisation demands, is providing the opportunity for reorganisation and modernisation. In addition to the production of improved working documents, better controls are being provided for management.

Courses and Exhibitions

25 April-3 May
International Machine and Precision Tool Exhibition.
Venue: La Roch-sur-Foron, France.

11-13 May
Symposium on Instrumentation and Computation in Process Development and Plant Design (organised by the Institution of Chemical Engineers, the Society of Instrument Technology, and the British Computer Society).
Venue: The Central Hall, Westminster.
Enquiries: to the Institution of Chemical Engineers, 16 Belgrave Square, London, SW1.

25 May-4 June
Business Efficiency Exhibition.
Venue: Olympia, London.
Enquiries: Office Appliance & Business Equipment Trade Association, 11 Dowgate Hill London, E.C.4.

15-20 June
International Conference on Information Processing.
(Organised by UNESCO).
Venue: Paris.
Enquiries: to the Hon. Secretary, Group B, British Conference of Automation and Computation, c/o The Institution of Electrical Engineers, Savoy Place, London, WC1.

22-25 June
First Conference of the British Computer Society, (Papers and symposia on varied aspects of ADP).
Venue: Cambridge.
Enquiries: to the British Computer Society Ltd., c/o The University Mathematical Laboratory, Cambridge.

Appreciation Courses for Management

The computer manufacturers provide various courses, graded to suit the varying needs of potential users

THE remarkable thing about the ADP appreciation courses for management run by the British computer manufacturers is generally the surprise of students at the end of the instruction when they find how much they really have learned. To the uninitiated, few things in this world seem more beyond the normal human ken than the complexities of a digital computer installation, and more than one executive goes on these courses with a sinking feeling in his heart. I will be lucky, he tells himself, if I understand the first thing about it.

And so he might, had the manufacturers drawn up their management appreciation syllabuses to include an attempt to explain the complexities. As it is, they have designed their courses to deal with basic principles with the result that, whether a course lasts three days or three weeks, most students will thereafter have a sound idea of how a computer works—and, more important, of the possibilities and limitations of existing ADP systems.

To be more precise, existing appreciation courses cover the following topics:

1. **How a computer works**—with a description of the input media, storage capacity, control and arithmetic units and ouput media of the machine (or machines) made by the company concerned. To put this over successfully, however, this part of the instruction must deal with features common to all computers.

2. **Getting a job on to a computer**—involved in this are the preparation of flow chart diagrams and the basic principles of programming and coding.

3. **Examination of some current applications**—usually case histories of some of the jobs being tackled by the equipment of the company concerned.

4. **The philosophy and economics of data processing,** with special reference to the company's thinking on these matters.

Other matters that may be touched on include the training and selection of staff, how the binary code works and pre-installation planning.

The Binary Code

Teaching binary arithmetic, for example, can be simplified so that it falls within the mental grasp of the layman of reasonable intelligence. If it is explained that a computer's arithmetic is performed by means of valves or transistors and

that these are always in one of *two* conditions—active or inactive, in other words On or Off—it follows that a computer, basically, can only accept numbers which are expressed in terms of only *two* symbols—1 and 0. This is done by taking an ordinary decimal number, say 75, to the base 2.

Thus:

$$75=64+8+2+1$$
$$=1.2^6+0.2^5+0.2^4+1.2^3+0.2^2+1.2^1+1.2^0$$

(*a binary convention is that* $1=2^0$)

Taking then the coefficients of each expression, we have 1001011 which is 75 expressed in binary form and, as in decimal arithmetic, the value of each binary digit (or ' bit ' as it is called) depends on its position in the binary number taken as a whole.

Once he grasps this, the student is able to learn how a computer adds, subtracts, multiplies and divides.

This example has been dealt with at some length because it demonstrates how simply the lecturer can put over the technicalities that must be included in any ADP appreciation course.

However, the purpose of such courses is not simply to make the executive *au fait* in a superficial sense with computer language and techniques. Rather, they are to give him a perspective on ADP so that, together with his own powers of judgement, he will be able to make a valuable contribution on whether or not his company should order a computer and, if ordered, how best to use it.

The following notes describe some of the courses now available from the computer manufacturers.

EMI Electronics Ltd.

This company started computer appreciation courses at their Hayes, Middlesex, headquarters late in 1958 and report a very good response, particularly from people overseas. Several executives from Sweden, Holland and France have attended.

These courses have a strong bias towards programming because the company felt there was a general need among customers and potential users for instruction in such techniques. Each course lasts three weeks and takes place approximately every three months. All aspects of programming are covered, and the fees are 50 guineas.

As already mentioned, response has been good and the courses held to date have all been filled to capacity. The average age group of students is between 35 and 45.

Additionally, EMI is encouraging two- or

Executives attending the ICT management course at Bradenham Manor, High Wycombe, Bucks

three-day visits by top executives to familiarise them with the latest computer techniques.

English Electric

This company started their computer appreciation courses in 1956 to help people from senior management jobs to assess the value of computers in management and design. They last two days and are held at irregular intervals in the company's training centre in Stafford. Fees are 20 guineas exclusive of accommodation.

The content of these courses is described as 'an introduction to computers on a broad front, but usually with emphasis on one particular field, e.g., design or management.' This includes demonstrations of a computer system in operation as well as instruction in the principles of programming, with students themselves being asked to draw up a simple programme.

Demand, reports the company, exceeds the number of places, which is restricted to about ten on each course to allow more opportunity for individual discussion. Students are drawn from technical or non-technical posts according to the emphasis of the course in question.

Ferranti Ltd.

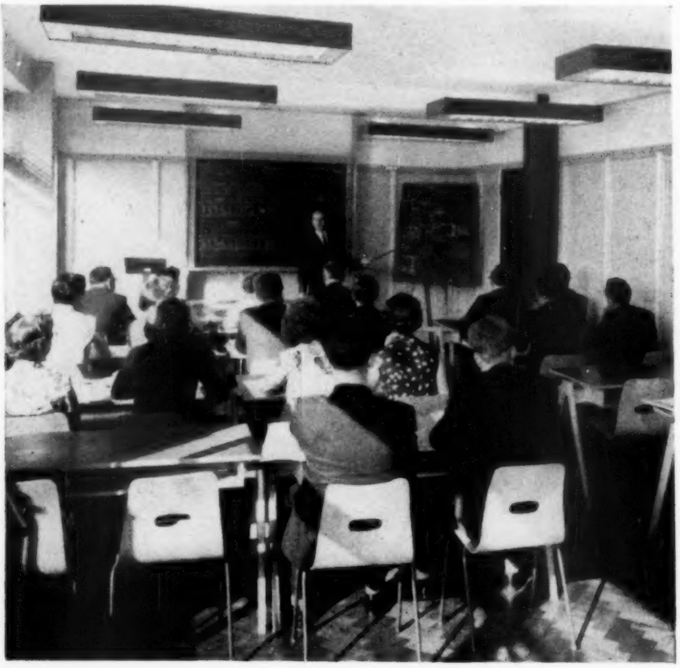
The first management appreciation course held by Ferranti was staged in May 1956, because, even by this comparatively early date, it had become evident to the company from their programming courses that there were people who wanted to understand the scope and place of a computer within an organization without going into the intricacies of its use.

Appreciation courses are held at the company's London training centre (21 Portland Place, W1) roughly once a quarter. They last for three days and the fee is 15 guineas. The course is non-residential.

At first it was necessary for the company to restrict numbers but now there are signs of a slackening in demand, possibly, the company explains, because of competitive courses elsewhere. Those attending, they report, now seem to have a greater interest in programming than earlier students.

The emphasis of the courses is on the use of computers for administrative and industrial applications, as a means of providing facts from which managements can make decisions. They point out that this should not be confused with routine data-processing operations—pay-roll, for instance—which simply produce electronically the same end-product as before, namely, a pay-slip.

Those attending are generally in their forties and come both from technical and non-technical jobs. They comprise three distinguishable groups: those attending for a general appreciation; those



An IBM instructor explains how an accounting machine type bar is positioned for printing letters or figures

making a first step in a detailed system or feasibility study; and those with a purely personal interest.

IBM (United Kingdom) Ltd

Educational facilities, states this company, are a traditional service provided free of charge and it seems that the 'ADP public,' as it were, has not been slow to take advantage of this offer. During 1958 almost 1,800 enrolments were accepted and in 1959 this figure is expected to grow to 2,500.

Classes are run for executives who are anxious to gain a broad understanding of conventional punched card equipment or of comprehensive ADP systems. There is also a wide variety of courses which deal with the programming and operating of business machines ranging from a small key punch to the most powerful computer. Except where otherwise stated, all these are held at the company's London headquarters in Wigmore Street.

Four types of IBM courses concern this survey, as follows:

- General Appreciation Courses;
- Executive Courses;
- Scientific Appreciation Courses; and
- Management Decision-making Sessions.

General Appreciation Courses

These were started early in 1957 mainly to give managers a better understanding of punched card methods and procedures. They last one week and are held every two months. Subjects covered include purpose and value of the punched card, function and purpose of commonly met punched card machines, and organization and procedure within an installation. The predominant age. group of those attending is between 30 and 40 and they come chiefly from non-technical jobs- Demand, reports the company, regularly exceeds the number of places.

Executive Courses

These were started in January 1959 for the same reason that the company runs general appreciation courses. They include the following classes:

- Four-day executive appreciation courses at three-monthly intervals;
- One-day top management appreciation courses at intervals;
- Special courses for specific industries covering machines, applications and pre-installation planning. As in the case of top management appreciation courses, these are held at varying intervals.

Most of the people attending these courses are in the 30-45 age group; they come both from technical and non-technical posts, but mainly from commercial jobs.

Last year 250 people attended IBM's executive courses and the company expect the 1959 figure to top this by far. They plan to expand the number and content of the classes.

Scientific Appreciation Courses

These began in November 1958 and are held in London, Birmingham, Glasgow, and Manchester. Plans are in hand to expand them, but at present they consist of two-day courses held at intervals. They cover scientific applications for research, design, production and accounting. As might be expected, nearly all enrolments are of technical people and so far demand equals the number of places available.

Management Decision-making Sessions

These offer a new computer training technique for management. They last two days and are held at irregular intervals. They are for what the company describes as 'middle-top' management.

Leo Computers Ltd.

Management appreciation courses in ADP were launched by Leo in December 1956 in response to requests for an appreciation course to complement the type of instruction the company had been running since 1955.

The courses are held at the company's training centre at Cadby Hall and last for five days. They take place at intervals of about one month and cost 25 guineas, including meals.

Briefly the course covers:

- how a computer works;
- the principles of coding;
- getting a job on to a computer;
- examination of some current applications;
- the economics of data processing;
- training and selection of staff; and
- the selection of computer applications.

The number of places is about equal to the demand which comes mainly from middle-aged executives, chiefly accountants, consultants and systems analysts. The major aim of the course,

says Leo, is to equip managements to make sound judgements on computer matters and to control staff working on computers.

Metropolitan-Vickers

This company holds no management appreciation courses at present but they are planned to begin in the middle of this year. These will be built round the *Metrovick 1010* computer which will form the nucleus of a data processing centre now being established in Manchester. This centre is where the management appreciation courses will take place.

National Cash Register Co, Ltd

The first course on the *National Elliott 405* was held in February 1956, and was designed to provide a three-week course which gave an introduction to, and appreciation of, the *405* and programming.

National Cash courses are at present held mainly at their London headquarters (206 Marylebone Road, London, NW1). Some, however, have been held in Glasgow and Edinburgh and similar courses are being arranged this year in large cities such as Manchester and Nottingham.

There are four types of course: one-day, two-day, one-week and three-week, the fees for these being respectively—no charge, four guineas, ten guineas and thirty guineas.

The one-day course consists of a broad appreciation of the *405*, *405M* and *802* computers plus a general introduction to ADP and to programming. These are held about twelve times a year.

The two-day course is held in the large provincial cities, and has recently been started in London as well, and consists of roughly the same instruction as the one-day course, but naturally gives a more thorough coverage. Six of these are planned for 1959.

The one-week course is designed to give an appreciation of how the company's computers can be used in integrated data processing systems. Various applications are discussed and the various units are dealt with in some detail. In addition, one and a half days are devoted to programming. These courses are held six times a year.

The three-week course is intended to provide basic programming knowledge for those who are actually intending to programme the *405* and *405M* computers and for those members of management and O & M teams who want a more detailed knowledge of ADP subjects. These courses are held four times a year.

The company reports that demand in general equals the number of places. The predominant age-group of those taking the programming courses is 20-30 years and of those taking the appreciation instruction between 30 and 40 years.

International Computers and Tabulators

This of course is the new company formed from the merger of the British Tabulating Machine Company and the Powers-Samas Group. However, because of commitments undertaken before the merger, ICT is continuing with the training courses previously run by the two companies. In addition, ICT has introduced a timely and interesting one-day appreciation course for journalists.

The British Tabulating part of ICT courses continues to be spread over three centres: the Hollerith Computer Centre in Hertford Street, London, W1; Moor Hall at Cookham in Berkshire; and the company's latest training centre, Bradenham Manor, near High Wycombe, Bucks.

Courses at the Hertford Street centre (apart from the one-day course for journalists) are of two types: a one-day directors' computer appreciation course and a four-day course for middle and senior management.

At Moor Hall, there is a two-week computer appreciation and application course for Hollerith equipment, exclusive of computers, and a large number of courses for operators of electro-mechanical and electronic punched card machinery.

Bradenham Manor is the main centre of training activity. Courses there cover programming chiefly, and last either three or five weeks, but there is also a two-week appreciation course for executives. Another interesting venture at Bradenham Manor is a four-day appreciation course for systems study personnel.

The Powers-Samas Group training branch is located at Fulwood Place, London, WC1. Various courses are held here, most of the places being allocated to users of Powers-Samas equipment; others are admitted, however, as space allows. The courses are non-residential and no charge is made by the company.

The courses are for five distinct groups: senior executives, junior and middle management, office managers, programmers and machine operators. Senior executive courses are limited to those with the status of chief accountant and above and last five days. Appreciation courses for middle and junior management last two days, while those for office managers are designed for those among them who are about to install the company's punched card machines.

Government Experience of Automatic Data Processing

AN EVOLUTIONARY RATHER THAN A REVOLUTIONARY PROGRAMME WILL BE BASED ON CAREFUL PLANNING

AUTOMATIC DATA PROCESSING was inaugurated by Mr F J ERROLL, MP, Economic Secretary to the Treasury, at a meeting at the Institute of Directors, 10 Belgrave Square, London, on March 12, 1959.

In his inaugural speech Mr Erroll said:

When the Editorial Director invited me to attend this function he asked me to tell you something about Government plans for using electronic computers. But before doing so I should like to say how much I welcome the enterprise of Business Publications in deciding to launch a journal of this kind. It deserves a welcome because at this comparatively early stage in the development of automatic data processing, the more we can learn of the experiences and views of others working in the same field the better it will be for all of us. I welcome it, too, because it will bring to the notice of a wider circle of people the great possibilities which these new techniques hold in the field of business efficiency and scientific management.

In an increasingly competitive world it is essential for British industry to be in the forefront with new technical skills and technical developments. Automatic data processing—ADP for short—is one of the most important of these. I am delighted that it will be possible for so many pages of this new journal to be devoted to describing the exhilarating new contribution which the British electronics industry is making in the ADP world. I hope, too, that we shall read of many examples of ways in which British commerce and industry are putting these new techniques to good use.

But now let me tell you about automatic data processing in Government. This is a field in which we have every reason to be proud of the achievements of Government Departments. The forerunners of these elaborate and costly devices were, after all, developed very largely because of the initiative and financial backing of the Department of Scientific and Industrial Research. Indeed, much of the initial research was done in their laboratories. This work continues vigorously. Our scientists are now looking not just at the problem of calculation, but at the way in which the human mind sets about these tasks; in fact, they are looking at the possible mechanisation of the simpler forms of 'thinking.'

We can be proud too of the fact that Government Research establishments contain a score or

Mr F J Erroll, MP, Economic Secretary to the Treasury, in conversation with Dr George Copeman, Editorial Director of AUTOMATIC DATA PROCESSING, *and Mr B F Levett, President of the Office Appliance and Business Equipment Trades Association*

more large computers helping scientists and engineers in their tasks.

In the Forefront

But my main topic this afternoon is not the work of ADP in scientific research or engineering, but in the everyday business of Government Departments. Here, too, we can claim to be in the forefront of progress. Already six ADP systems are at work in various Departments. One further large one is installed and will be starting work soon, four more systems are on order, and some half dozen other major schemes are in an advanced stage of planning. Besides all these, well over a score of other schemes are being considered. In short, by the early nineteen-sixties, we should have about 30 major systems in operation.

But you may well ask what sort of work are these machines doing? So far, our ADP schemes have largely been cautious applications of computers to existing bread-and-butter jobs such as payroll, statistics and stores accounting. And, moreover, we started with comparatively small projects. We have, for instance, a computer doing a payroll for some 20,000 staff; another preparing statistics about income tax, profits tax, and surtax in order to estimate yields for budget forecasts; a third is preparing and issuing agricultural deficiency payments.

But already very worthwhile results have been achieved. One fairly small computer doing an engineering stock control job for the Post Office Supplies Department is able to produce an accurate and comprehensive provisioning statement in about a third of the time it took under the old system. You can, I am sure, appreciate the effect this has on the control of a stockholding of perhaps £48 million.

Financial Savings

Statistical work bulks large in the Government Service today, and this is a sphere where ADP can make a major contribution. There are direct financial savings. ADP can do the arithmetic more economically than ordinary punched card machines; also, it can do the work which previously had to be done by hand of judging the soundness of the figures on the basic returns and throwing out anything seemingly unrealistic or inconsistent.

There are also substantial indirect savings. The value of statistics generally declines the older the original information becomes, and ADP reduces the inevitable time lag considerably. Let me give an example. You may not know, but for some time we have been making a continuing survey of the expenses of running a home. It is called the 'Family Expenditure Survey.' This involves analysing information taken from some 3,000 households a year, a complicated and lengthy job that has needed three-quarters of a million or so

punched cards to be prepared and then analysed. Using ordinary office machines it took up to 18 months before all the statistical tables could be derived. Last year, for the first time, a joint team from several Departments did this analysis by ADP and the principal figures were ready after six months. In future surveys they will probably be out after only four months—and at little more than half the cost.

Similarly, the use of a computer to do the Board of Trade's Census of Distribution has enabled fuller figures to be made available six months earlier and at much less cost than by earlier methods.

Pay Accounts

Turning to the future, we are already planning and introducing more ambitious projects. We are bringing into use a large system which will in due course deal with the pay for 112,000 Post Office staff in the London area. Another system costing about £750,000 has been ordered which will keep the pay accounts for practically the whole of the British Army. The Service Departments and the Ministry of Supply are studying the application of ADP to their Stores Accounting procedures. Already at an advanced planning stage is a scheme for the Royal Army Ordnance Corps which will control an inventory range of some 200,000 items, and do about 8,000 account postings each day.

The Government, then, can expect to be one of the biggest customers in the ADP field. It is difficult to quote a firm figure today because much depends on detailed studies of potential areas of work and on future technical developments, but in all the Government will probably spend between £10 million and £15 million on ADP in the next seven to 10 years.

Problems

A programme such as this means a tremendous effort on the part of both management and staff. Detailed reviews have to be made to ensure that an ADP scheme is justified. These skilled staff have to be found and trained to do these reviews and also to programme and run the ADP systems when they have been installed. But important as these problems are to middle management, ADP poses still more awkward problems for higher management. The development of devices that process vast quantities of data not only alters the pattern and flow of work in the office; it alters the form and organisation of our activities. Indeed, the full power of ADP may never be harnessed until existing executive functions of Government Departments have been reorganised, sometimes in a way that cuts right across tradition, to take advantage of that power and flexibility.

As regards our experience within Government, I should like to pay tribute to the willing co-operation of staff representatives both in considering individual schemes and on the National Whitley Council. This is in keeping with the well-established traditions of joint consultation within the Service.

The Government's future programme then is a big one, but it is an evolutionary one rather than a revolutionary one, for experience has everywhere shown the virtue of careful preparation and planning and of building up from comparatively small beginnings. ADP will not completely change the pattern of Government service work either in a few months or in a few years. There will always be considerable areas of work where human brains and human skills will be the most efficient tools for the job. But ADP is already proving of immense value to us and will in the future, I am sure, play an increasing part in our official lives.

A New Approach

Introducing Mr Erroll, Mr Philip Zimmerman, Chairman of Business Publications Ltd, said:

'During the last 12 to 18 months, a remarkable change has become quite clearly observable in management thinking about the use of electronic computers and their accompanying equipment. Early computers were used for single tasks, like payroll computation; the approach was piecemeal. Today there is the more ambitious but also the more realistic concept of complete integration. This also involves the factory as well as office administration.

'Computers are already being applied to the job of handling the whole flow of information which starts when a customer gives an order, takes in production planning and progress and stock control, etc, and ends only when the customer has taken delivery, inventories have been up-dated, accounts invoiced and paid, and, in the final stage, management acquainted with the details of profit or loss on the order.

'I believe that, at last, when the significance of this is being grasped, we really do have a new industrial revolution on our hands.'

New Techniques & Equipment

NEW ANALOGUE COMPUTER

EASE is the name of a new analogue computer being marketed in Britain by Winston Electronics. This machine is of American design and claimed to be as accurate as any on the market today. Control, too, is very simple because the whole problem is concentrated on the one patchboard and there are no additional switches or controls to be manipulated. Another advantage claimed is the machine's reliability; expressed in terms of 'down' time—that is, the time which has to be spent on checking and maintenance—this amounts to five per cent. In other words, the machine has a problem-solving time of 95 per cent.

The smallest size of *Ease* has 20 amplifiers, but this can be built up to an installation of several hundred amplifiers. At the moment, the normal size of the machine is 60 amplifiers at a cost of roughly £290 to £300 per amplifier.

Winston Electronics,
Shepperton, Middlesex.

AIRLINE BOOKINGS BY COMPUTER

AN order for electronic equipment worth $12 million which is claimed will provide the fastest and most modern seat reservation system in the world was announced last month by Ferranti-Packard Electric Limited, the wholly-owned Canadian subsidiary of Ferranti Ltd. The system will be made available in the United Kingdom and the Continent through the parent Company, Ferranti Ltd.

The basic idea around which the present equipment is designed was conceived by Trans-Canada Air Lines systems experts in 1954. They consulted Ferranti-Packard to carry out the design and development work.

The system comprises equipment which sends information to and receives answers from a central computer. For this purpose, a device known as a transactor is used, which will be located in every TCA booking office across Canada. In the larger offices, up to fifty transactors or more may be installed.

The transactor, and its techniques, is the vital new part of this new system but it has many other applications such as the administration involved in retail stores, mail order firms, stock and stores control and other businesses where information is derived at many places, some distant from the central office.

In operation, a pencil-marked card is inserted in the Transactor by a TCA clerk requesting a reservation on a certain flight. The central computer determines whether or not space is available on the flight in question and the information comes back to the transactor causing it to punch a hole in the edge of the card providing the answer to the reservation request.

There is no practical limit to the number of transactors that can be run off a central computer. When inserting a card in the transactor

An air hostess of Trans-Canada Air Lines requesting a flight reservation by inserting a card in a device known as a transactor, which sends information to, and receives information from, a central computer. This device will be used in every TCA booking office in Canada. The system was developed by Ferranti-Packard Electric Limited, the Canadian subsidiary of Ferranti Ltd

the information required is obtained practically instantaneously and red and green lights on the transactor indicate whether the computer is engaged or free for use.

As long ago as 1952, TCA realised that a new reservation system must be developed to handle the projected increased volume of airline traffic. In undertaking this work, Ferranti-Packard research and development engineers had first to learn step by step the airline's business and booking procedure.

There were many essential considerations. As the system would have to be operated by ticket agents without electronic training, simplicity of operation was of prime importance. Flexibility was essential to provide for the expanding number of TCA offices and it also had to provide for other operational functions together with reservations handling. Most important of all, it had to be accurate and reliable.

Ferranti-Packard Electric Ltd,
Industry Street, Toronto 15,
Ontario, Canada.

AUTOMATION FOR BANKERS

WHAT is claimed to be the world's fastest document sorter has been developed by the Burroughs Adding Machine Company in the United States. It is a precision electronic device that reads characters printed with magnetic ink on bank cheques and other documents and sorts them at the rate of more than 1,500 per minute.

Ray R Eppert, president of the company, described the new magnetic character sorter as a 'major breakthrough in solving the biggest bottleneck in banking—sorting a tidal wave of millions of cheques, deposit slips and other documents.' In most banks, thousands of cheques pour in daily from a variety of sources. Before posting of the items to individual accounts, the cheques must be placed in proper order or sequence.

The new machine, sorting ten times as fast as a single person in manual operations, will free employees from tedious, time consuming tasks for more important banking duties.

By adding conversion equipment, the sorter will fit into the most sophisticated automation systems, including those which utilise full-scale electronic computers for cheque handling, proving book-keeping and preparation of customers' statements. One of its features is its ability to process mixed paper and card cheques of various sizes.

Burroughs Adding Machines Ltd,
Avon House, 356 Oxford St,
London, W1.

CORRECTING ERRORS IN RADIO MESSAGES

A NEW automatic error-correcting device which makes for a much higher degree of accuracy in the transmission of radio-telegraphy has been developed by Marconi Wireless Telegraphy Company Ltd. Known as the *Autoplex*, this device not only speeds the service, but also enables HF radio telegraph networks and ionospheric scatter circuits to be connected to the international Telex system.

Up to the present, however, this has been largely impossible, not so much from the actual transmission and reception aspect, but because there has existed no straightforward way of detecting and obtaining correction of the errors which almost inevitably creep in during transmission periods when long distances are involved. Largely because of this, most radio-telegraph traffic is at present transmitted and received by operators; under these circumstances the man at the receiving end can inspect his copy at once and request the re-transmission of any part of the text about which he is in doubt. But whilst this procedure answers the 'error-detection' problem it also imposes serious disadvantages, not the least of which is that it limits the extension of the HF telegraph network beyond the radio terminal and therefore cannot be connected direct into the Telex network.

Marconi Autoplex effects the answers to these problems by providing a fully electronic means of detecting, and immediately correcting, errors which arise during automatic transmission, thus permitting the use of data processing machinery and computers at the receiving end. On receipt of a character which has become distorted in transmission, the Autoplex equipment at the receiving end initiates a request for repetition which is transmitted to the sending station on another frequency. This signal, when received, interrupts the flow of information and automatically initiates re-transmission of the group of characters which contains the queried one. This done, the transmission reverts to normal. No human intervention is involved at any stage.

Marconi Wireless Telegraphy
Company Ltd,
Chelmsford, Essex.

FLAME CUTTING TOOL

A PORT and starboard computer-controlled gas cutting machine will be the main feature on the British Oxygen Company's stand at this year's Engineering, Marine, Welding and Nuclear Energy Exhibition (Olympia, April 16 to 30).

The machine is designed to form an integral part of the modern shipyard and may do away with the need to compile tables of off-sets to define the shape of the hull transverse sections. At present, full size patterns, or templates, are taken direct from the scrieve board and these are used to mark out the plates after which the greater part of them are flame-cut. The computer-controlled flame cutter will also eliminate template making.

The machine, the first of its kind in Britain, consists of a transverse boom carrying a cutting head on either side of a fixed central track. Hydraulic servo motors move the carriage along the track and the cutting heads on the boom. The motors are controlled by a Ferranti magnetic tape mechanism with feed-back devices. The heads move in opposition to one another so that both port and starboard plates for the same ship can be cut simultaneously.

A ten-minute colour film will be

shown on the stand to demonstrate computer-controlled gas cutting and explain how the machine works.

British Oxygen Company Ltd,
Bridgewater House,
Cleveland Row, St James's, SW1.

ACOUSTIC ENCLOSURES FOR QUIETER TABULATING ROOMS

FOR MACHINE noise control the Burgess Products Co Ltd have designed for the accounting machine operator's desk an acoustic enclosure which absorbs noise inseparable from work on the machine.

The enclosure consists of four separate panels easily assembled by unskilled labour. The panels have an inner lining of perforated mild steel sheet and an outer facing of plain mild steel sheet, the intervening space being packed with non-inflammable, non-hygroscopic, sound-absorbent material. Clatter from the accounting machine travels through the perforations of the inner lining and is quickly 'blotted up' by the sound-absorbent material behind it. The enclosures are easily movable, attractively finished in a silver-grey hammer paint, supported on four metal feet, and cost £47.10.0 each.

Burgess Products Co Ltd,
PO Box 11,
Hinckley, Leicestershire.

RAPID PHOTOGRAPHY CATCHES CATHODE SIGNALS

THE difficulties of permanently recording and projecting information presented on a cathode ray tube have been solved by a rapid processing photographic projector produced by Kelvin & Hughes Ltd.

Designed initially in conjunction with the Ministry of Supply, the equipment, which has been in full scale production for some time, is now being sold in quantity to the United States of America. There it is being used to investigate and help solve some air traffic control radar problems, and to record data from high speed computers.

Three projectors have been installed by the Civil Aeronautics Administration at its Technical Development Centre, Indianapolis. There the equipment is projecting air traffic information from cathode ray tubes fed by two radar systems geographically spaced 50 miles apart. A photographic record is made of the CRT face, which is then developed by the equipment and projected on to a large screen. The processing cycle, can take as little as 6 seconds and the film will then keep indefinitely.

Films and processing solutions have been designed specifically for the equipment by Ilford Ltd.

Kelvin & Hughes Ltd,
Livingstone College, Knotts Green,
London, E10.

US TRANSDUCERS TO BE MADE IN BRITAIN

A RANGE of pressure pick-ups designed by the Consolidated Electro-Dynamic Corporation, USA, are to be manufactured by the Solartron Electronic Group Ltd. These pick-ups are transducers which convert pressure readings into electrical signals to be fed into data processing or recording equipment. Designed for precise measurement of pressure where size is an important factor and pressure changes are too rapid for observation and recording by conventional devices, these pick-ups give high accuracy and are temperature compensated from −350° F to +650° F.

The Solartron Electronic Group Ltd,
45 Thames Street,
Kingston-on-Thames, Surrey.

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